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PLEISTOCENE GEOLOGY OF NEW YORK STATE.[1] *I*

INTRODUCTION

THE primacy of New York among the states in population, wealth, manufacture and commerce is based on its physical characters—geologic structure, physiographic relief and geographic relations. The state has the greatest range and perfection in its stratigraphic series and the greatest variety in physiographic features. In scenery other states may possess single features of surpassing grandeur and beauty, like the Colorado Grand Canyon, Yosemite Valley, Crater Lake, the mountains of the Cordillera or the snow-capped volcanic cones of the northwest, but for abundance and variety of beautiful scenery of educational value New York may claim first place. In the variety and excellence of Pleistocene phenomena the state probably excels any other equal area of the earth's surface. This is due to the varied and unusual physiography combined with a favoring attitude of the area in relation to the continental glacier. The features of special excellence occur largely in the western part of the state. These are the series of more than twenty parallel, north-sloping valleys which hold the unique series of twelve so-called Finger lakes; the remarkable succession of glacial lakes in the Ontario drainage area; the conspicuous, abandoned channels of the rivers that drained those lakes; the surpassing display of drumlins, of kames and eskers; the fine series of mo-

[1] Annual address of the president of the Geological Society of America, read on December 28, 1912. The numerous maps which illustrated this address are here omitted.

raines, and the large number of Postglacial ravines.

The purpose of this writing is to utilize this remarkable display of Pleistocene phenomena in illustration of the glacial history and in brief discussion of some problems in the philosophy of glaciation.

MULTIPLE GLACIATION

The accepted facts of multiple glaciation in the Mississippi basin coupled with proofs of Prewisconsin drift in Pennsylvania and New Jersey and on Long Island, with accumulating evidences in New England, demands the theoretical acceptance of at least dual glaciation for New York state. But the positive proof, in the field, of a Prewisconsin ice sheet has not been found. In several localities the deeper till is so unlike the upper till that it strongly suggests a separate origin. Some singular topographic features are not satisfactorily explained without appeal to the earlier ice invasions. The Rutland Hollow, east of Watertown, is an example. Many erosion features, specially in the St. Lawrence district, seem inconsonant with the work of the latest ice.[2] However, we have found no example of interglacial or warm-climate deposits interbedded in the till. Such should be expected and sought, but at present we can only say that multiple glaciation in New York, at least north of Long Island, is quite certain in our philosophy but that it remains unproven in observation.

Although our glacial phenomena in New York are doubtless not the effects of merely the latest or Laurentian ice sheet, the latter so strongly dominates that for purpose of this writing it is impracticable to attempt discrimination, and unless specially noted it will be understood that reference is to the latest, or Wisconsin, glaciation.

[2] For discussion of this subject see N. Y. State Museum Bulletins, No. 145, pp. 164–172; No. 160, pp. 17–18.

LAURENTIAN (LABRADORIAN) ICE BODY

The reach or extent of the latest ice sheet has long been known in a general way through the early work of Upham, Lewis and Wright in tracing the terminal moraine. In later years the stretches of the terminal moraine which lie in New York have been reexamined, on Long Island by Woodworth and Fuller and Veatch, and in Cattaraugus county by Leverett. There are two small areas in the state which the ice sheet did not cover, the south side of Long Island and the district partly enclosed by the northward bend of the Allegheny River.

At its maximum the ice sheet covered the highest points in the state, the Adirondack (5,344 feet) and the Catskill (4,205 feet) mountains. Judging from the Antarctic and Greenland ice caps the surface of the Laurentian shield was a low dome of fairly uniform curvature, uninfluenced by the irregularities of the submerged land surface. Our only means of estimating the thickness of the ice cap is by assuming a gradient of the surface slope, as suggested by observations on the existing polar ice fields. Such data, however, can be safely used only in a suggestive way when applied to the Laurentian ice shield, because the difference in latitude must be an important factor. The border of our ice field, in latitude 41 to 44 degrees, was subjected to so much greater solar radiation and consequent higher temperatures, with heavy precipitation and rains, that it must have had increased plasticity and resultant mobility, giving the surface slope diminished gradient. But on the other hand the snow supply over the central area or alimentation ground of the ice field must have been greater than over the polar fields, which might give greater depth and steeper gradients toward the interior of the field. The anticyclonic winds over the ice cap, re-

cently emphasized by Hobbs, would brush the snow toward the borders of the field and so tend to reduce the surface slope of the interior.

Shackelton found that the great outlet glacier in Antarctica, named the Beardmore, had a rise of 80 feet per mile for 100 miles, with declining rate inland, attaining about 11,000 feet in 275 miles, or 40 feet per mile for the entire distance. If we assume a slope of 60 feet per mile for the glacier surface over western New York it gives an altitude of over 9,000 feet on the area of Lake Ontario, the margin of the ice sheet lying at near 2,000 feet altitude. Over central New York (district of Oneida Lake) the altitude would be about the same; and if to this we add 30 feet per mile to the middle of the Adirondacks it gives 3,000 feet more, or over 12,000 feet altitude. If we assume 40 feet per mile on the Hudson-Champlain meridian it gives 12,500 feet of ice on the Canadian boundary. Thirty feet per mile gives over 9,000 feet of ice. These figures may be somewhat excessive, but they at least prove the fact of a great thickness of solid water piled over the state. The effect of such weight will be noted later.

The ice mass had a spreading or radial flow, as a plastic body, due to its own weight. The prevailing direction over New York was southwestward, except that in the lower Hudson Valley the flow was southward, conforming to the valley. The waning or thinning ice sheet was deflected by the larger topographic relief, and when the ice mass resting over the Ontario basin ceased to be impelled by thrust from the northeast it developed a spreading flow, radiating from the area now occupied by Lake Ontario. This is well shown by the orientation of the drumlins in the Ontario basin. A good illustration of valley diversion is shown in the maps, depicting how the Hudson lobe and the Ontario lobe pushed into the Mohawk Valley from opposite directions, impounding glacial waters between them. As the direction of flow near the margin of the ice sheet must incline to right angle, or normal to the ice front, the direction of latest movement in any district can be approximately known if the ice limit is determined. The series of maps accompanying this writing show several stages in the waning and disappearance of the ice and suggest the direction of flow at different positions.

The set of maps gives fifteen positions of the ice front during its recession across the state. A larger number could be depicted, but only those have been selected which have some significance in the lake and drainage history. The criteria used in locating the ice front positions are the moraines and the ice-border river channels, the latter correlating with lake levels and shore features.

The recession of the ice front was certainly not steady or continuous, but must have had considerable oscillation, readvances and reretreats. The heavier belts of moraine and the lines of long-lived ice-border drainage probably represent readvanced positions.

The length of time represented by the passage of the ice front across New York is unknown, but is certainly scores of thousands of years. Probably 100,000 years is not too long. We may not judge the rate of waning by the present behavior of the ice fronts in Greenland and Antarctica, as the climatic factors due to difference of latitude must have been effective. If the oscillations of the ice front were due to any irregular or nonperiodic variations of climate, then we can have no idea of the time involved either in the advance or the waning of the ice sheet. And the only periodicity in climatic factors now recognized

that seems adequate is the precession of the equinoxes, having a variable but average period of about 21,000 years. Taylor has studied the Cincinnati-Mackinac moraine series from this viewpoint, and concludes that the fifteen rather equally spaced moraines represent 75,000 to 150,000 years, using the minimum length of the precession period.[3] The eight or ten morainic belts which we now recognize in western New York may correlate with that many on the Cincinnati-Mackinac meridian, but the recession of the ice front on the Hudson-Champlain meridian probably represents a much longer time than the Ohio-Michigan series.

If the changes in geologic climates be due to variation in solar radiation it is conceivable that some minor secularity might be responsible for the oscillations of the ice front. Variation in the amount of carbon dioxide content of the atmosphere can more reasonably be invoked to explain the larger and more irregular changes in ancient climates than for the shorter and more regular changes that caused the ice front oscillations. The same is true of continental elevation as a cause of colder climate.

GEOLOGIC EFFECTS OF THE ICE SHEET

Erosional work.—The subject relating to glaciers that has been the cause of the greatest difference of opinion is the erosive power or destructional work. The writer will here not discuss seriously glacial erosion in general, but only so far as it applies to New York.[4]

That mountain glaciers abrade their valleys and by moderate erosional work change the V-shape to the U-shape has long been apparent. The destructive work at the head of the glacier in production of cirques is fully recognized, although this is largely atmospheric effect. All argument for deep erosion by glaciers based on the abrasional or plucking action of mountain or stream glaciers fails when applied to New York, as there were no effective mountain glaciers in New England and New York, at least not during the waning of the Laurentian ice body. The ice disappeared from the more elevated tracts, while lingering in the lowlands. Whatever the erosive power attributed to mountain glaciers of Norway or New Zealand, it can not be invoked here, as New York had no such glaciers. We have to consider only the work of a continental glacier. Whatever destructive effects an ice cap may have under its central or subcentral mass, it has long been admitted that it is not a vigorous erosive agent in its border zone or dissipating belt. The district in New York, the Finger Lake area, which has been used in illustration of glacial valley erosion, was always in merely the outer zone, or that of predominant deposition by the Laurentian glacier. All students of New York geology practically agree on the lack of vigorous ice erosion over all the rest of the state. Those who have worked in the Adirondacks and in the Champlain and St. Lawrence valleys have noted the proofs of a weak erosion.[5] It has been shown by Gilbert and the writer that erosion was weak on the Ontario lowland of western New York. The claim for deep erosion has been only for the valleys of the Finger lakes, specially Cayuga and Seneca, the claim based chiefly on anomalous topographic features.

The advocates of glacial deepening of the valleys appeal either to vigorous currents at the bottom of the ice sheet or to the tongue-like lobations of the ice front, to deeply gouge the bottoms of the valleys so as to produce hanging side valleys and

[3] *Journal of Geology*, Vol. 5, pp. 421–465, 1897.

[4] For the argument in general see *Bull. Geol. Soc. Am.*, Vol. 16, pp. 13–74, 1905.

[5] See N. Y. State Museum Bull. 145, pp. 147, 171–172, 1910.

"oversteepening" of the lower slopes of the main valleys. The existence of effective basal currents in the region under consideration seems highly improbable. The general land slope was opposed to the ice flow, that is, the ice was moving on an upslope. The lower or basal ice was very heavily burdened with rock rubbish and would naturally serve as the bridge over which the upper ice traveled, partly by shearing and partly by superior plasticity. But if for argument we grant the existence of effective bottom currents, then we are forced to concede that under the conditions of great vertical pressure, with the movement on an up-slope in soft shale rocks, the erosion would have to be by abrasion and not by plucking. At its intensest, abrasion must be a slow and a self-checking process. Long ago Russell emphasized the fact that plasticity of the ice is reduced in proportion to its burden of drift. Admitting this, it follows that an excess of rock stuff in the basal ice, the inevitable result of heavy erosion, would produce stagnation. Moreover, the excessive product of grinding would serve as a buffer to protect the bed rock, just as a stream full-loaded with detritus ceases to erode.

If the lobations or valley tongues of the ice margin had any erosive effect comparable to mountain glaciers, such work should have been greatest south of the land divide, or where gravity directly assisted the flow. But the conspicuous lack of erosive work on the uplands and south of the divide is frankly admitted. In description of the area covering the eight quadrangles of the Watkins-Ithaca-Elmira-Owego district, in the U. S. Geological Survey Folio 169, Professor Tarr, who was the leading advocate of glacial erosion of the Finger Lake valleys, wrote:

> In harmony with this evidence of slight erosion is the fact that the mature upland divide areas have suffered notable modification only by deposition and not at all, so far as can be seen, by ice erosion (page 16).
>
> In the southern half of the area glacial erosion was not sufficient to remove the products of preglacial decay from the hills, nor, so far as any evidence goes to show, to modify perceptibly the topography even of the valleys (page 31).

North of the divide the lobations of the ice front were pushed up the valleys by the pressure of the ice in their rear, and were so heavily loaded with drift that they were not eroding, but depositing. The fact of superload of drift is clearly shown by Tarr's map of the surficial geology. South of the divide morainal drift is almost entirely lacking in the south-leading valleys and only scantily represented in the larger east and west Susquehanna and Chemung valleys. Tarr says:

> On the upland, south of the area of the recessional moraines, little moraine material is found and no definite system has been worked out.
>
> The complex of moraines in the northern part of the Watkins Glen quadrangle and the northwestern part of the Catatonk quadrangle, contrasted with the general absence of moraines in the southern half of the area, forms one of the most striking features of the Quaternary geology (page 17).

The heavy morainal drift in the valleys north of the divide was not derived from erosion of those valleys, but was the accumulated rock rubbish acquired by the lower part of the ice sheet during its entire journey across the state. When the ice was thick enough to override the divide and flow south it was the superficial, drift-free ice that passed across, while the lower, drift-loaded and relatively stagnant ice reposed in the Ontario basin and its valleys, serving as the bridge that was overriden by the clearer and more plastic superficial layers. In evidence of this is the relative absence of drift south of the divide, and the almost entire absence of crystalline rocks or far-traveled material. Quoting Tarr:

In the uplands south of the recessional moraines foreign fragments are much more rare, and in some parts of the uplands a careful search is required to find even a small pebble of crystalline rock, while bowlders are practically absent (page 16).

To whatever extent the ice in the margin of the snow field was produced by the centrifugal, anticyclonic winds from the interior of the ice cap, as suggested by Hobbs from study of the existing continental glaciers,[6] it also favored lack of drift in the periphery of the ice body. With the waning and thinning of the ice cap the drift-loaded lower ice was finally uncovered so as to constitute the marginal belt, and was then subjected to thrust or push from the thicker body on the north. At this stage the heavy moraine deposits were made in the valleys, producing the present drainage divide, and the lobations of the ice front built the crescentic lateral-terminal ridges north of the divide. At a later stage of the waning, when the required factors were properly combined and balanced, the drumlins were constructed on the lowlands, northward.

Many facts are cited by Tarr showing the impotency of the latest ice sheet, and he finally admitted that the

Wisconsin ice sheet failed to notably modify the topography in the greater part of this area (page 16).

This would seem to terminate the debate about glacial erosion in the Finger Lake district. But it does not, as the responsibility for the anomalous topography is shifted back to the Prewisconsin glaciers.

This carries with it the necessity of believing in 1,500 feet of vertical erosion in the Seneca Valley by the continued ice work of at least two periods of glacial occupation, separated by an interval of gorge cutting several times as long as the postglacial interval (page 16).

The statement is warranted, therefore, that these valleys have been profoundly modified by glacial erosion, both by deepening and broadening (page 30).

But here, as in the process of glacial stream erosion, the bulk of the work was done by an earlier ice advance (page 31).

It is admitted that ice sheets may have some individuality and that successive sheets on the same territory may have somewhat different behavior and produce different effects, due to differences in the climatic, topographic and drift factors. But it does not seem reasonable that one ice sheet could deepen Seneca Valley 1,500 feet, while its successor did practically no eroding at all. If the Prewisconsin ice sheet had such remarkable excavating power it should have produced conspicuous erosional effects elsewhere than in the valleys, and specially in the southern part of the state, and should have piled heavy "old drift" deposits beyond the reach of the Wisconsin ice.

The drift burden of the Laurentian ice sheet is represented not merely by the mass of the moraines and the volume of detritus carried away by the glacial drainage, but also by the enormous bulk of drift built into the drumlins. Even if the drumlins were partly constructed by the earlier ice sheet they can not, because of their location, represent any product of deep erosion of the sections of Seneca and Cayuga valleys in question. There are no heavy moraine deposits south of the Valley-Heads moraine, for the terminal moraine is not massive, and the ancient drift in Pennsylvania and New Jersey is not excessive in volume. The only other disposal of the great volume of débris that should have been produced by deepening of the valleys 1,500 feet must have been by outwash of the glacial drainage. But when the valley-train and outwash deposits attributed to the latest ice are considered there is no

[6] "Characteristics of Existing Glaciers," 1911.

very large volume left to represent any earlier drainage.

The entire argument for deep ice erosion in the Finger Lake region is based on physiographic features, hanging valleys and "oversteepened" valley walls. The writer believes that sufficient attention has not been given to the effects of Prepleistocene drainage in connection with the climatic, topographic and diastrophic factors. The high elevation of the northern part of the continent in Tertiary time seems to be a fact, and accompanied by warm climate. If necessary to explain phenomena we may assume effective vertical movements in our region. The Tertiary was certainly a time of vigorous drainage and remarkable valley-cutting in northern lands. When the fiord valleys were making in other lands what was doing here? Undoubtedly our rivers were also active, and the deep valleys of central New York are one result.

At the last Baltimore meeting of the society the writer exhibited a series of maps suggesting the drainage evolution in New York.[7] The high "Hung-up" valleys with northeast by southwest direction, and mostly without present streams, seem to be an inheritance from the primitive drainage on the new land surface. The drainage lines of the upper tributaries to the Delaware and Susquehanna rivers preserve their original direction. During some Prepleistocene time the development of subsequent valleys along the strike of the thick and weak Ontario strata resulted in a great east and west valley, carrying a great trunk stream, the hypothetical Ontarian River. Into this valley was drawn from the south, as obsequent streams, all the drainage of western and central New York and the adjacent territory of northern Pennsylvania. The Susquehanna River turned northward at Elmira and occupied the Seneca Valley, which probably accounts for the excessive depth of the valley, a drilling at Watkins of 1,200 feet failing to reach rock. The Genesee River is the one stream which fully represents the Preglacial northward flow, having held to its northward direction clear across the state in spite of the tendency of glaciation to force it into southward flow. All the other drainage of south-central New York was forced to southward escape, mostly in tribute to the Susquehanna and through the new rock gorge at Towanda, Pa. A late and probably rapid land uplift, rejuvenating the obsequent drainage, will probably be found to satisfactorily account for the great depth and other anomalous features that have been used as arguments for deep glacial erosion in New York. Interglacial drainage may also be important in this work.

It will now be understood that when the earliest ice sheet invaded New York it found a topography unlike the present, a remarkable series of parallel, deep, open, north-sloping valleys that headed southward, the larger ones in Pennsylvania. The present divides in the valleys are due to the moraine fillings left by the ice. The deep canyon-like valleys were occupied by the glacier and some abrasion and smoothing of the walls was inevitable. But it should not be forgotten that the ice tongues in these valleys were not mountain glaciers, but merely lobations of a drift-burdened margin of an ice sheet moving on an upslope. Conceding some erosive power to the ice tongues in the valley, then instead of deepening the valleys and oversteepening the walls and so producing the present convex cross-profiles they should have cut the walls and widened the valleys and produced concave profiles. In the work of stream glaciers convexity of valley slope is succeeded by concavity. In final word, to

[7] Geol. Soc. Am., *Bull.*, Vol. 20, pp. 668–670, 1910.

a discussion already too long, in the opinion of the writer all the facts and philosophy of ice erosion argue against deep glacial erosion in the Finger Lake valleys.

One interesting product of glacial erosion is to be noted. These are some hills which have the form and attitude of true drumlins, but which are composed of soft shale, shaped into drumlin form. These rocdrumlins will be described later.

CONSTRUCTIONAL WORK.

Subglacial: Rocdrumlins.—The general drift sheet presents no special features meriting description at this time. The important subglacial deposits are the rocdrumlins. New York state probably has the best display of these interesting hills of any district in the world; in number, variety of form, variety in orientation, difference in composition and in the clear relationship to the correlating moraines.

Much space might be given to description of these singular and most beautiful hills, but they have already been quite fully described in a Bulletin of the State Museum.[8]

Possibly in other regions there may be drumlins produced by the ice overriding and reshaping moraines, but all the true drumlins observed in New York are certainly constructional in their origin. The New York moraines are mostly water-laid drift, especially north of the divide, the débris in the ice being largely grasped by the glacial drainage. If the drumlins were moraine accumulations they would have morainal composition and structure. On the contrary, they are very compact till, distinctly bedded with concentric structure. The best exhibition of the bedding is shown along the shore of Lake Ontario, between Sodus and Oswego, where the undercutting by the waves has dissected numerous drumlins from top to bottom and in different directions. Sand or gravel within the mass of the drumlin is of infrequent occurrence, though some of the drumlins between Clyde and Savannah hold considerable sand in their superficial layers. Many drumlins exhibit decided difference between the deeper and the superficial till, sometimes so pronounced as to suggest two epochs of construction.

Along the belt of outcrop of the soft Salina shales there are drumlins which have a shale base, and perhaps some with a shale core. Fifteen miles northwest of Syracuse and west of Baldwinsville the drumlin forms are entirely shale. The deeply weathered clay rock supplied to the ice sheet a plastic material similar in its behavior to the ground moraine. These hills are not true drumlins. They are wholly erosional in origin, as indeed are the true drumlins in their shaping. We have called them rocdrumlins, using the Celtic prefix. It is possible that similar forms will be found in the Champlain-Hudson Valley, shaped out of the softer Ordovician shales. The ice sheet does not appear to have had scraping force sufficient to shape into the drumlin curve any rock hills of harder materials than soft shale, though bosses of crystalline rocks in the St. Lawrence Valley and other districts of long-continued abrasion are rounded and smoothed on the struck sides.

The mechanics of drumlin construction is a complex problem. The required cooperation and balancing of several dynamic factors make the drumlins exceptional features even in the glaciated territory. The more important constructional factors appear to be: (1) An excessive amount of drift; (2) the drift of clayey or adhesive and plastic material; (3) such thickness of marginal ice and with such relation to the rearward ice body that the whole depth of

[8] N. Y. State Museum Bull. 111, 1907.

ice accepts a thrustal movement, producing a sliding motion of the ice in ground-contact; (4) such temperature or physical condition as to allow plasticity and some differential motion within the ice, essential for the overriding of the growing obstruction instead of its removal. Here is found a singular balancing of two opposing factors, rigidity and plasticity; rigidity holding the ice mass, as a whole, to its thrustal motion, while at the same time bands or currents within the ice sheet have unequal motion, permitting the curving or arching flow over the growing hill of drift. The drumlin-making process appears to be a plastering-on and a rubbing-down, depending on the condition of more friction between clay and clay than between clay and ice. The resulting form of the growing obstruction is that which offers the greatest resistance to removal, or the least resistance to the passage of the ice over it. The molding action of the ice sheet is well shown by the minor ridges in some districts, the secondary and tertiary inferior ridges lying on the flanks of or between the primary ridges suggest the wood-molding struck in the planing mill.

The complex of forces and conditions necessary for drumlin construction explains their peculiar distribution, orientation and form. In the western half of New York the rich display of drumlins (nearly a thousand ridges being shown by the contours on the Palmyra sheet alone) is practically limited to the territory north of the divide, where the drift was profuse and the thinning ice was pushing on an upslope. In the Ontario basin their attitude or direction of the major axis is radial to the middle of the basin, varying from due east to southwest. In the Erie basin a group about Chautauqua Lake points southeast, while in the Mohawk valley north of Richfield Springs a group has westward pointing. In the Champlain and Hudson valleys the drumlins point southward. In the St. Lawrence Valley they show the latest and spreading flow. Everywhere they show the later ice-flow direction.

The most typical drumlin form, that which seems to express the most vigorous action and effective balancing of the several factors, is an elongated oval with steep convex side slopes, and these are found in the middle of the drumlin belt. New York exhibits all possible variations from this form. The shorter ridges, sometimes approaching dome-shape, but usually with some irregularity or lack of symmetry, are found at the north or proximate side of the drumlin belt, which suggests that the broad form is the product of less perfect work. The much elongated and attenuated ridges lie at the south or ultimate side of the belt and indicate the more uniform or rigid flow of the ice sheet with deficiency of drift.

In the western end of the state the till sheet over large areas has been rubbed into a fluted or washboard form on a large scale, but with low relief. It is inferred that this drumlinized surface with ribs one fourth to one half mile wide represents the work of thick ice, having great weight and vertical pressure, with diminished plasticity and carrying only a moderate load of drift. The direction of the flutings, southwestward, is the direction of flow of the maximum ice body.

In central New York we have been able to definitely correlate the drumlin belt with its synchronous moraine; to determine the position of the ice front during the drumlin-making episode. On the meridian of Seneca and Cayuga lakes the drumlins of the north side of the belt are more scattering and irregular in form. In the middle of the belt they are close-set, typical, elongated ovals. Southward they become close-set ridges with secondary flutings; while at

the south edge of the belt they are slender ridges and flutings, too attenuated to be represented by the twenty-feet contours of the topographic sheets. It would require at least five-feet contours to show the frontal drumlinized surface. Two miles in front of the most southerly ridges indicated on the Geneva sheet lies a weak but definite moraine. It is weak because the ice had plastered its load of drift into the drumlins.

From the relation of the ice front to the glacial waters and other data it has been roughly estimated that the thickness of the ice over the middle of the drumlin belt was about 900 feet, or more than 700 feet over the tops of the highest drumlins.

Marginal: Moraines.—The only map published to the present time that shows moraines in detail is that by Tarr in the Watkins Glen-Catatonk folio (No. 169), which is accompanied by good description. This map, Surficial Geology, covers eight quadrangles of the south-central portion of the state and includes the upper (southern) ends of the Seneca and Cayuga valleys. Except a few fragmentary moraines in the east and west stretch of the Susquehanna and Chemung valleys there are almost no moraines south of the divide, as already noted in this writing. The lines of drift massing show decided lobation of the ice in the valleys north of the divide and conformity to the land surface. The plastic ice was here flowing on its own deposits and had no erosive power. Probably the only moraines in the state that can properly be called "lateral" lie in these valleys.

In the west half of the state the heavier or more conspicuous morainic belts have been approximately located though little precise mapping has been attempted. The most recent and definite is by Leverett,[9] and a sketch map, Fig. 11, page 15, in the Folio 169. These morainic belts clearly show the larger lobation of the waning ice sheet in the Ontario and Erie basins.

In the east half of the state the moraines have been located in only few places, excepting the terminal moraine. In the Hudson and Champlain valleys Woodworth has recognized some fragments and ice-contacts. This difference in moraine development between the two parts of the state is due to the difference in the gross topography. A glance at the map shows that on the Hudson-Champlain meridian the distance covered by the receding ice front is greater than in the Ontario basin, so spreading the drift over more area. The rocks in the east part of the state are more resistant to erosion, due to kind and structure. The Hudson ice lobe and its successor in the Champlain Valley were always faced by ocean waters and the terminal drift in the bottom section of the great valley was mostly scattered and buried under the water deposits. On the high grounds east and west of the marine inlet the surfaces are so rough, or even mountainous, that the moraine deposits lack continuity and volume. It will be very difficult to trace morainic belts across the Hudson-Champlain Valley with certainty, though it is important to know the lines of the receding ice front.

WORK OF GLACIAL WATERS

Erosional Work of Streams. Normal Drainage.—It is apparent that the flow of glacial waters freely away from the ice could occur only south of the divide, and as the present divide was established by morainal filling and lies north of the preglacial divide much of the southward flow was drainage of ice-dammed waters, and that some of the present south-leading channels were cut by the glacial waters. The preglacial flow of the main streams

[9] U. S. Geol. Surv., Monograph XLI., 1902.

was northward, but the tributaries had various directions. The glacial drainage took advantage of the favoring valleys and connected them into sequence of southward flow. Tarr thought that the work of stream diversion and of channel erosion was mainly Prewisconsin, for the district described in the Folio 169 (page 30). He specially cites the outlet of Cayuga Lake, the gorge of Tioughnioga creek and the gorge of Chemung River behind Hawes hill, west of Elmira. The copious waters from the waning Laurentian ice sheet were supplied with such volume of detritus that they were largely aggrading agents. It is possible that the south-leading valleys were mostly established by Prewisconsin glacial drainage and that the work of the latest glacial floods was chiefly transportative. In the eastern half of the state the glacial outflow was freely into the Susquehanna and Delaware escape or into the Hudson-Champlain marine inlet, so there was no necessity for cutting new channels.

The heaviest normal drainage was that in south-central New York, concentrated in the Susquehanna, which cut the gorge south of Sayre, Pa., and the river which drained Lake Iroquois through the Mohawk Valley, the Iromohawk. This great river was the predecessor of the St. Lawrence, which it probably exceeded in volume, as it carried not only the outflow of the glacial Great Lakes, but the copious waters from the glacial melting.

Subglacial Drainage.—This class of glacial streams has been noted chiefly in relation to eskers, which fall under another head in this writing. It is not likely that all eskers were laid down in the beds of streams actually beneath, or in tunnels under, the ice sheet, though some probably were. Probably most subglacial or englacial streams were full loaded with detritus, and it is not likely that many streams beneath the ice margin were so free of drift or under such hydraulic pressure as to seriously erode their beds. However, a few peculiar channels, or "dead" creeks, have been noted which have such form and relations as to suggest erosional flow beneath the stagnant margin of the ice. One of these bayou-like channels is that of Dead creek, a tributary of Seneca River, lying southwest of Baldwinsville, and mapped on the Baldwinsville sheet.

Marginal Drainage.—This class of drainage phenomena included many of the most conspicuous and interesting features connected with the disappearance of the ice sheet, and they have been the subject of much work by the writer. The ice-border drainage channels are important as they locate ice-front positions and determine the altitude of the glacial lakes which they drained. They are humanly, or economically, important since they have graded the ways for many lines of communication or transportation. And they are specially valuable for geologic instruction since they are widely distributed and easily recognized products of long extinct agencies.

It is evident that stream flow along the ice margin could occur only where the land surface sloped toward the ice, and consequently only north of the divide. The remarkable physiography of the western half of the state favored the production of glacial lakes, which required outlet channels for the imprisoned waters.

The most notable series of ice-border drainage channels occur in five districts. (1) On the south slope of the Erie basin, where the ice-impounded waters in the north-sloping valleys escaped westward into the Erian glacial lakes. (2) Along the south slope of the Ontario basin the glacial waters found eastward escape toward the Mohawk-Hudson depression. (3) On the

Helderberg scarp, west of Albany, the waters of the Ontario and Mohawk basins escaped southward into the Hudson marine inlet. (4) In the district about Rome, at the east end of the Ontario basin, the waters from both the north and the west flowed along the sides of the ice lobe to reach the Mohawk Valley. (5) On the north and west sides of the Lowville highland the waters of the southwestern Adirondacks and the Black Valley forced their passage into Lake Iroquois.

The channels leading east through central New York, more conspicuously developed in the Syracuse district, were the predecessors of Niagara River in their function, the equal of Niagara in volume, and the rival of Niagara in cataract phenomena.

The successor of the Iromohawk and the immediate predecessor of the St. Lawrence was the outlet river of the second Lake Iroquois. This flowed across the north point of the Adirondack highland, at Covey Gulf, on the international boundary, with further flow in ice border channels along the slopes northwest of Plattsburg, on the Dannemora and Moors quadrangles.

CONSTRUCTIONAL WORK OF STREAMS.

Subglacial: Eskers.—The singular ridges of gravel, the laggard material in the beds of glacial streams, are well represented in the western part of the state and occur in the eastern part. Those lying in the northwestern section of the state have been studied, but the results are not published. Tarr describes in Folio 169 (pp. 22–23) several which lie in the Susquehanna drainage territory, and of large dimensions, and Carney recognizes nine on the Moravia quadrangle. Eskers may not occur on southward slopes where the glacial streams had steeper gradient and free flow, but in localities where the ice margin was comparatively stagnant and the drainage was sluggish.

The argument for subglacial origin of eskers finds some support in the New York examples. Tarr regards some of those in the Susquehanna district as certainly made by subglacial streams. An esker four miles east of Clayton was deposited about 350 feet beneath the level of Lake Iroquois, which was laving the ice front, and it is difficult to explain how it could have been constructed and its definite ridge-form preserved unless it was built directly on the ground. The same argument applies to the Ingoraham esker, north of Plattsburg.

Extraglacial: Kames.—Isolated mounds of sand or gravel are usually embryo deltas of glacial streams, and are commonly associated with eskers. By linear multiplication they not infrequently grade into esker ridges.

As kames are built at the debouchure of glacial streams, they indicate positions of the ice edge. Areas of kames lie in belts of recessional moraines, and indeed constitute a large part of the New York moraines. The glacial débris which was not spread as the till sheet or rubbed into drumlins was largely gathered up by the drainage and dropped as some form of water-laid drift.

In western New York a few large kame areas are not closely connected or clearly associated with any conspicuous moraine belt, but nevertheless must represent recessional moraine. It is possible that some smaller kames might have been built by land drainage into lateral glacial lakelets, but detritus from land erosion must commonly have produced deltas or sandplains and be easily recognized by form and association. The great development of kames, at least in western New York, is north of the divide, and they were built in the waters of glacial lakes. This association with standing waters is so pronounced

that it gives force to the idea that all typical kames are formed by streams debouching into water bodies, and sometimes by subglacial streams under hydraulic pressure. Streams debouching on the land would naturally produce either outwash plains or valley trains. The fact that basins or kettles, believed to be due to melting out of buried ice blocks, are usually abundant in areas of kames, seems to prove that the materials were laid down in standing water in close association with the stagnant ice margin, either on the ice or in hollows and valleys and reentrants in the ice.

Extraglacial: Outwash Plains.—These are the gravel and sand deposits spread out in front of the glacier by the outflow of the glacial streams and which can not be classed on the one hand as deltas or on the other as valley trains. Water-laid drift in facial contact or close association with the moraines and which can not be distinguished either as delta, kame or valley train, may safely be put in the indefinite class of outwash gravel plains. North of the divide where built in lakes they grade into deltas and kames. South of the divide they constitute most of the valley fillings, especially of the broader valleys which lay athwart the direction of ice flow.

A not uncommon feature of the gravel plains and one which shows the close relation to the glacier front, is the existence of ice-block kettles. The term "pitted plain" has been applied to the sand plains with numerous kettles. Another feature indicating their genesis is the preservation in some cases of the ice-contact slope. The outwash sand and gravel plains are more common in the southwest part of the state and in the Mohawk Valley. In the highlands the drainage was too free and vigorous. In the Champlain-Hudson Valley, lower levels, the sea-level waters distributed the glacial stream detritus, or it was buried under the deluge of sand contributed by the rivers since the ice disappeared. The very extensive sandplains on both sides of the Hudson River and Lake Champlain, for example, the Saratoga district, must be classed as marine deltas. But on the walls of the great valley above the marine plain Woodworth has noted ice-contact slopes of glacial outwash deposits. In the Susquehanna district Tarr found numerous plains of this class.

Extraglacial: Valley-Trains.—South of the divide, where the drainage had free escape, some detrital filling of the valleys is common and occasionally abundant. The high-level flood plains along the valley sides and the elevated deltas of lateral tributaries testify to the glacial floods and their burden of detritus. The deposit by glacial flow is of course intermingled with and in places buried under land stream detritus. The valley trains may be regarded as heading in outwash plains, and one might regard the glacial gravel deposits in the entire length of the valleys north of the terminal moraine as outwash. This view would restrict the true valley-trains to the fillings of valleys beyond the terminal moraine or reach of the ice sheet. In this latter view the valley-train drift would occur in New York only along the south side of Long Island, and in the small area south of the Alleghany River.

HERMAN L. FAIRCHILD
UNIVERSITY OF ROCHESTER

(To be concluded)

SCIENTIFIC NOTES AND NEWS

PROFESSOR WILLY WIEN, of Würzburg, will deliver at Columbia University, during the month of April, a series of lectures on recent developments in theoretical physics. Professor Wien received the Nobel prize in physics in 1911 and is well known for his researches in radiation and the electrical constitution of matter.

On the occasion of the dedication of the new building of the Medical Department of the University of Georgia, on January 29, the LL.D. degree was conferred on Dr. William M. Polk, dean of Cornell University Medical College, and Dr. J. A. Witherspoon, president-elect of the American Medical Association.

Dr. F. Körte, who has been an important figure in the development of medicine in Germany, celebrated, on January 16, his ninety-fifth birthday.

King Christian has decorated Dr. V. Poulsen and Professor P. O. Pedersen with the medal of merit in gold on account of the honor they have brought to Denmark by their work in connection with wireless telegraphy and telegraphones.

M. B. Baillaud, director of the Paris Observatory, has been elected president, and M. H. Deslandres, director of the Meudon Observatory, vice-president, of the Paris Bureau des Longitudes for 1913.

Dr. Eberhard Rimann, of the Technical Institute at Dresden, has been appointed director of the Geological Survey at Brazil in succession to Professor E. Hussac.

Dr. E. M. Kindle, since 1901 paleontologist in the U. S. Geological Survey, has accepted a similar position on the Geological Survey of Canada.

Professor H. E. Clifford, who holds the McKay professorship of electrical engineering at Harvard University, will go in the second half-year to Annapolis, to organize graduate study in electrical engineering at the Naval Academy.

Richard M. Holman, B.A. (Stanford, '07), senior instructor in botany, University of the Philippines, stationed from June, 1910, to June, 1912, at the College of Agriculture, Los Banos, Philippine Islands, is on leave of absence which extends to September, 1913. He is at present engaged in graduate study at Leipzig University.

Professor James F. Kemp, of Columbia University, delivered a short course of lectures during the mouth of January, in the Faculty of Applied Science at McGill University, on "The Services of Geology to the Mining Industry."

Dr. Martin Fischer, of the University of Cincinnati, delivered the address at the third winter commencement of St. Louis University School of Medicine, January 30, on the subject, "Principles of Treatment of Edema and Nephritis."

During the week of January 13 to 18, Mr. Vilhjalmer Stefansson visited the University of North Dakota, at which he was a former student, and delivered a series of three lectures, as follows: January 13, "Five Years of Arctic Exploration"; January 14, "The Discovery of the Blond Eskimo"; January 15, "The Mind of Primitive Man." Later in the week he was a guest of the Icelandic Society, of which he is a member.

On January 29, Dr. Joseph Barrell, professor of structural geology in Yale University, gave an illustrated lecture on "A Reconstruction of Connecticut's Geologic Past," under the auspices of the Yale chapter of Sigma Xi.

The seventh of the present course of Harvey Society lectures will be given at the New York Academy of Medicine on February 15, by Dr. Theodore C. Janeway, of Columbia University, on "Nephritic Hypertension: Clinical and Experimental Studies."

The Mutual Life Insurance Company is providing a series of lectures in New York City. The lecture of January 29 was delivered by Surgeon-General Rupert Blue, United States Public Health Service, who spoke on the bubonic plague and other contagious diseases.

Professor Isaiah Bowman, of Yale University, delivered a lecture on "The Physiography of the Central Andes" before the Geological Department of Columbia University on January 28.

Dr. Orville Horwitz, until his illness head of the department of Genito-Urinal Surgery in Jefferson Medical College, Philadelphia, died on January 28, aged fifty-five years.

Dr. James P. Tuttle, fifty-six years of age, a practising surgeon and professor emeritus

of surgery in the Polyclinic Hospital, New York, died on January 30.

DR. O. T. WILLIAMS, lecturer on pharmacology and demonstrator of biochemistry in the University of Liverpool, has died at the age of thirty-five years.

PROFESSOR BINZ, who held the chair of pharmacology at Bonn, has died at the age of eighty years.

DR. F. TELLER, chief geologist at the "Geologische Reichsanstalt," Vienna, and member of the Vienna Academy of Sciences, died on January 10, in his sixty-first year.

DR. R. COLLETT, professor of zoology in the University of Christiania, has died at the age of seventy years.

DR. AUGUSTUS WITKOWSKI, professor of experimental physics in the University of Cracow, died on January 21, at fifty-eight years of age.

THE Archduke Rainer, the oldest member of the Imperial Austro-Hungarian family, who died on January 27, at eighty-five years of age, was actively interested in scientific and artistic activity. Foreign journals state that at the Vienna Academy of Sciences, of which he was curator, he never missed an important sitting, while the Austrian museums owed their development largely to his support.

IN the Senate of the United States on January 24 Mr. Cummins submitted the following resolution, which was considered and agreed to:

Resolved, That the Committee on Naval Affairs is hereby authorized and directed to investigate the affairs of the Naval Observatory and its relation to the American Ephemeris and Nautical Almanac; and, further, to inquire into the wisdom and propriety of placing the management of the Naval Observatory in the hands of scientists, without regard to their connection with the Navy of the United States.

Resolved further, That the said committee be directed to make report of the matters herein referred to it as soon as practicable.

THE Harriman Research Laboratory, which was established in New York City in 1910 and is maintained by Mrs. E. H. Harriman for the study of chemical problems connected with disease and owns and operates a building on the grounds of Roosevelt Hospital, has been incorporated.

A GOLD medal is offered by the American Laryngological Association for the best essay pertaining to laryngology or rhinology, preference being given to essays offering new suggestions of practical value arising from original work.

THE heirs of Herr Adolf Schwabacher, the Berlin banker, have established a foundation with 100,000 Marks, the income of which will be used to confer a prize in medicine every five years.

THE Astronomical Society of Mexico has decided, beginning from 1913, to offer a medal and diploma to any astronomer who discovers a comet. The medal will bear the name of "Carolina Herschel Medal."

THE ninth International Physiological Congress will be held at Groningen September 2–6 under the presidency of Professor H. J. Hamburger.

AT a special general meeting of the Royal Geographical Society, on January 15, the president, Lord Curzon, of Kedleston, moved the resolution: "That the society approve of the election of women as fellows," and it was carried by 130 votes to 51.

THE Jesup lectures on Heredity and Sex, by Dr. Thomas H. Morgan, professor of experimental zoology in Columbia University, are now being given in the lecture hall of the Museum of Natural History on Wednesday evenings at 8:15. The subjects are as follows:

February 5—"The Evolution of Sex."
February 12—"The Mechanism of Sex Determination."
February 19—"The Mendelian Principles of Heredity and their Bearing on Sex."
February 26—"Secondary Sexual Characters and their Relation to Darwin's Theory of Sexual Selection."
March 5—"The Effects of Castration and of Grafting on the Secondary Sexual Characters."
March 12—"Parthenogenesis and Sex."
March 19—"Inbreeding and Fertility."
March 26—"Special Cases of Sex Inheritance."

The Norman W. Harris lectures of Northwestern University will this year be given by Dr. J. S. Ames, professor of physics in Johns Hopkins University. The series, comprising six lectures on the subject "The Constitution of Matter," is as follows:

February 24—"General Properties of Matter; Mass."

February 25—"Corpuscles and Atoms; Electrical Mass."

February 26—"Radioactivity; Gravitation."

February 27—"Radiation; Formation of Molecules; Elasticity."

February 28—"Properties of Metals; Thermionics."

March 1—"Models of Atoms; Conclusion."

We learn from the *Journal* of the American Medical Association that on January 25 the American Society for Physicians' Study Travels, with national headquarters in Philadelphia and proposed branches throughout the United States, was formally organized at a meeting of prominent medical men at Philadelphia. Dr. James M. Anders was elected president and Dr. Albert Bernheim was chosen as secretary. The society proposes to send travel parties to foreign countries to report on the methods of leading medical men and scientists in Europe and South America. All physicians and scientific men qualified to become affiliated with the American Medical Association will be eligible for membership, and also associate and honorary members will be elected among the prominent medical and non-medical men of this and foreign countries.

On February 3 the city of Providence passed a resolution accepting as a gift from the Audubon Society of Rhode Island the Manly-Hardy collection of North American birds and also as a gift from Mr. Horace F. Carpenter his collection of shells and minerals with a library descriptive of the same. The conditions of the gifts are that they shall be properly cared for and exhibited at the Park Museum within three years from date of acceptance. This means that the city will erect an addition to the museum almost as large as the present structure, equipped to exhibit the collections. The Manly-Hardy collection of North American birds, which has just been purchased by the Audubon Society of Rhode Island through subscriptions of its members and friends, is one of the most valuable private collections in existence and represents thirty-three consecutive years of work on the part of Mr. Hardy and his daughter, Mrs. Fannie Hardy Eckstorm. The collection is remarkable for its many specimens in breeding plumage, for some extinct and for numerous rare species. The Carpenter collection of shells and minerals represents about fifty years' work by Mr. Horace F. Carpenter, of Providence, and contains over three thousand species of shells, about five hundred different kinds of minerals and a library valued at over $2,000.

UNIVERSITY AND EDUCATIONAL NEWS

Ohio-Miami Medical College of the University of Cincinnati, has received $125,000 from a donor whose name is being withheld. An effort is being made to raise an endowment fund of $1,000,000.

During the past year three wills, involving property valued at $125,000, have been probated in favor of Knox College. About half of this amount becomes available immediately for the endowment of a professorship in one of the departments of science, while the remainder is held in trust during the lifetime of the widow of one of the testators.

Mr. Eugene Meyer and his wife, of New York, have given Cornell University $10,000 to endow a fellowship in memory of their son, Edgar J. Meyer, who graduated from Sibley College in the class of 1905 and whose life was lost by the sinking of the *Titanic*. The purpose of the fellowship is to encourage research in mechanical and electrical engineering.

The *Journal* of the American Medical Association states that the College of Physicians and Surgeons of Chicago again passes under the control of the University of Illinois. This time it is a gift to the state institution partly

by the stockholders and partly by the alumni who purchased the stock not donated. The medical school has for several years held a contractual relationship with the University of Illinois, but that relationship was cancelled last spring. By the present transfer of all the stock, however, the medical school becomes an organic department of the university.

AN administrative committee of the faculty of the Johns Hopkins University has been appointed by the trustees to conduct the affairs of the university until a president is appointed. The chairman is Dr. William H. Welch, and the other members are Professors B. L. Gildersleeve, W. W. Willoughby, W. B. Clark, J. S. Ames, W. H. Howell and E. H. Griffin.

DR. J. W. W. STEPHENS has been appointed to the Sir Alfred Jones Chair of Tropical Medicine at Liverpool University, vacant through the resignation of Sir Ronald Ross, who has gone to live in London.

DISCUSSION AND CORRESPONDENCE

UNIVERSITY REGISTRATION STATISTICS

TO THE EDITOR OF SCIENCE: Unfortunately I was unable to see the proof of my contribution on "University Registration Statistics" to your issue of December 27, 1912, and, as a result, several errors have crept into the compilation which I desire to correct herewith.

Since the detailed figures for the *University of Nebraska* were not available at the time the article went to press, this institution was omitted from the table, consequently the refferences in the body of the article should be to twenty-eight instead of to twenty-nine institutions. The missing *Nebraska* figures are as follows: college, men, 464; college, women, 617; agriculture, 328; art, 19; forestry, 64; graduate school (non professional), 164; law, 222; medicine, 159; pedagogy, 148; pharmacy, 32; scientific schools, 376. After deducting the double registration of 110, it leaves a total fall registration on November 1, 1912, of 2,483. Of the 486 summer session students, 158 returned in the fall, giving a grand total of 2,811 students for the year.

The fall total at the *University of California* is 4,585, and not 4,741; and that of *Columbia* is 6,148 and not 6,153. The dagger after "extension and similar courses" under the *University of California* should be a plus sign. The grand totals at *Columbia* should read as follows: 1912: 9,002, 1911: 7,938, 1910: 7,411, 1909: 6,132, 1908: 5,677, 1903: 4,557.

The *Indiana* figures should read as follows: College, men, 709; college, women, 438; art, 45; graduate school, 70; journalism, 67; law, 108; medicine, 140; music, 58; pedagogy, 144; deduct double registration, 354; total, 1,423; summer session, 1,197; deduct 280 students who returned for work in fall; grand total, 2,340. Both *Indiana* and *Nebraska* should be omitted on page 889 among those institutions which have more than 1,400 students registered in the college.

The *Johns Hopkins* grand total for November 1, 1912, should read 944, and that for 1911, 1,120.

At the *University of Minnesota* the item of double registration should read 175, instead of 319, thus making the grand total 3,737. This grand total is exclusive of 1,326 students registered in "extension and similar courses," but this latter category of students was included in the figures for 1903 and for 1908–1911.

The grand total enrollment at the *University of Texas* for November 1, 1909, was 2,512, 1908: 2,410, 1903: 1,309.

	1912	1911	1904
Amherst	429	464	412
Brown (incl. graduate school)	934	933	988
Bryn Mawr (incl. graduate school)	444	440	441
College of the City of New York	1,109		
Dartmouth (incl. eng., med., grad. stud., and commerce)	1,294	1,385	926
Haverford	167	164	146
Lehigh	617	599	609
Massachusetts Institute of Technology	1,611	1,610	1.561
Mount Holyoke	748	771	674
Purdue	1,749	1,762	1,359
Smith	1,528	1,508	1,067
Vassar	1,044	1,055	979
Wellesley	1,424	1,433	1,050
Wesleyan	410	395	305
Williams	521	533	443

These changes in the table naturally necessitate certain changes in the body of the article on pages 887 and 889.

The enrollment as of November 1, 1912, of a number of colleges for men and women, and schools of technology is given in the preceding table.

Rudolf Tombo, Jr.
Columbia University

BUILDING STONES AND CLAY PRODUCTS

In the issue of Science for December 27, 1912, there appeared a review by George P. Merrill of "Building Stones and Clay Products" by Heinrich Ries. It seems to me that the criticisms thus set forth in the review are a trifle harsh and I would like to call attention to a few statements which seem inaccurate. The reviewer says:

> The portion devoted to stone contains nothing that is not to be found in other easily available works.

The fact that the work contains much information taken from American and foreign publications not even to be obtained in such a library as the Carnegie Library of Pittsburgh, would indicate that the information is not all *easily* available, while, in truth, a large part of it is practically *unavailable* to many of those who will make use of the book.

The second portion of the book, that devoted to clay products, he states "is little more than an abbreviation of what the author has already included in his well-known work, 'Clays, their Origin, Properties and Uses.'" In his work on clays, Dr. Ries devotes 42 pages to structural clay products, while in the book under criticism, 130 pages are given over to the subject. The new work contains 34 illustrations concerning clay products, only 6 of which were given in the book on clays. The section on clay products, if compared at all with the similar portion of the earlier book, is a decided *amplification* instead of an *abbreviation.*

All works of this character must be largely compilations and their value depends largely on the arrangement and the care in selecting the proper material from the wealth of publications at hand. Dr. Ries has apparently made good use of the available literature both American and foreign and has condensed it into a volume whose usefulness, for the class of readers for which it is intended, is, I believe, enhanced by such condensation.

Henry Leighton
University of Pittsburgh

QUOTATIONS

CORRESPONDENCE BETWEEN THE PRESIDENT OF WESLEYAN UNIVERSITY AND THE PROFESSOR OF ECONOMICS AND SOCIAL SCIENCE[1]

My Dear Prof. Fisher:—The press, far and wide, contain articles relative to remarks in reference to the churches of the country, reputed to have been uttered by you in a recent address in Hartford. I desire to know whether or not you have been correctly reported. If you have been incorrectly reported, will you please give me an exact statement of what you did say?

Sincerely yours,

William Arnold Shanklin

My Dear Dr. Shanklin:—In reply to your letter just received I would say that the report of my remarks before The Get Together Club in Hartford, last Wednesday evening, was substantially misleading. Partly by the omission of qualifying statements which made the setting and shaped the interpretation, partly by ascribing to me words and utterances which were not mine at all, and perhaps partly by the striking headlines which raised brief incidental remarks into the prominence of a principal theme, the original report, upon which apparently many newspaper conclusions and comments have been based was—as I should judge—decidedly unfair. This judgment of mine is confirmed in some degree at least, by the fact that the paper in which the report appeared was constrained by criticism in Hartford to offer me an opportunity to make corrections. There was, however, a large underlying element of truth in the report. I did not say that I would "throw Sunday wide open" or anything else of closely similar meaning. But I did say that I would allow very great freedom of Sunday observance, allowing a man pretty nearly anything that did not disturb the religious or other use of the day by others. I did say that I saw no religious inconsistency in

[1] The letters are all dated from Middletown on January 27.

a man's having an uproarious good time on Sunday; but I added that there should be no disturbance of the religious or other duties of the day by others. I did say that "I would," or that "I believe that I would" close up the churches temporarily, as an experiment. But I stated my reasons, with emphasis, because so many good, religious people have come to think of church going as a great part of the whole religious duty, and because, if there were no churches open for a time, these people would be constrained to turn to more important religious duties, of kindly service and the like. Just here I quoted the declaration of James as to the meaning of religion pure and undefiled.

The above will perhaps enable you to judge for yourself as to the degree of accuracy with which I was reported; but for a slight amplification of which I have just written, I am enclosing a copy of a letter which I sent in correction of the first report, and which was printed in the paper first reporting me, in its issue of last Saturday morning, January 25th.

Of course, not even all of what I am now placing at your disposal can make entirely clear my general attitude on Sunday observance; but it is probably quite enough to make you to see how and in what light I stood last Wednesday evening. And that, I am sure, is all of your present wants.

Very sincerely yours,
WILLARD C. FISHER

My Dear Prof. Fisher:—Your letter of this date is just received. Even after consideration of your explanation of your position, I find it difficult to believe that any one with a just appreciation of the work which the churches have done and are doing for the religious and moral life of the community, could seriously propose the closing of the churches, even as a temporary experiment. I am constrained to the conviction that your attitude in the matter is so far out of harmony with the spirit of the college, which, though in no wise sectarian, is and always has been profoundly in sympathy with Christian churches, that your continuance in your present official position is undesirable for the college or for yourself. I feel therefore compelled to request you to offer your resignation.

Most sincerely yours,
WILLIAM ARNOLD SHANKLIN

My Dear Dr. Shanklin:—Of course I shall respond at once to your request for my resignation. Here it is. It is given cheerfully, I trust, and in full appreciation of the situation. I do not expect, I do not even undertake, to frame for myself a judgment as to what I might think the correct course for the college to take in such a case. But my judgment is not needed and it might be biased. I am, however, free enough from prejudice to see very clearly that a college with the history and the constituency and support of Wesleyan, is not exactly the place for a man who holds such views as mine, and who can not suppress them. I leave the college, therefore, without a trace of ill will toward anybody connected with it. Indeed I go with the warmest wishes for the institution to which I have given the twenty best years of my life.

Very cordially yours,
WILLARD C. FISHER

My Dear Prof. Fisher:—I have your favor, resigning from the faculty of Wesleyan University. I hereby release you from your duties, pending the presentation of your resignation to the board of trustees. I shall recommend that your salary be paid in full for the present academic year.

Appreciating your spirit of good will to the college, I am,

Most sincerely yours,
WILLIAM ARNOLD SHANKLIN

SCIENTIFIC BOOKS

Manual of Conchology. Vol. XXI. Achatinellidæ (Amastrinæ). By ALPHEUS HYATT and HENRY A. PILSBRY. Leptachatina by C. MONTAGUE COOKE. Philadelphia. 1911.

The "Manual of Conchology," founded many years ago by George W. Tryon, was designed to include descriptions of all the known living Mollusca. In Tryon's day it was essentially a compilation, but even so quite invaluable to conchologists. When Tryon died, and Dr. H. A. Pilsbry took his place, the character of the work changed, and the new volumes came more and more to represent exhaustive original research. The treatment of the Helicidæ, for example, put the whole subject on a new footing, and stands to-day as one of the great classics of malacology. Naturally the later parts have contained descriptions of fewer species than the early ones, the more elaborate treatment requiring more space;

hence the progress through families and genera has been much slower. On the other hand, considering the character of the work and the numerous illustrations, we may well marvel at the size of the yearly volumes, representing an amount of labor which few of us could undertake, even if possessing the necessary skill.

Professor Alpheus Hyatt died in 1902, leaving a quantity of unpublished manuscript on the Achatinellidæ, those remarkably varied and interesting snails of the Hawaiian Islands. Some years later these materials were turned over to Professor Pilsbry to be incorporated in the Achatinellidæ of the "Manual." The finished work is accordingly issued under the names of Hyatt and Pilsbry, although the greater part is by the junior author. The large genus *Leptachatina* (92 pp.) is by Mr. C. M. Cooke, of the Bishop Museum, Honolulu. The Achatinellidæ consist of two subfamilies, the arboreal Achatinellinæ, with usually light or brightly colored shells, and the mainly terrestrial Amastrinæ. The whole family is confined to the Hawaiian Islands, excepting the genus *Fernandezia* from the island of Juan Fernandez, which is located in the group provisionally, in the absence of any knowledge of the soft anatomy. The volume under review contains only the Amastrinæ; before the Achatinellinæ are described Dr. Pilsbry will himself visit the islands, and gain a first-hand knowledge of the subject.

The exhaustive and logical treatment, with the fine colored plates, enables us to gain a very good idea of the evolution and development of the Amastrinæ. The subfamily is to be divided into two very distinct tribes, which if given special names would be Leptachatinini and Amastrini. The first of these consists of oviparous forms, with shells closely resembling those of the circumpolar genus *Cochlicopa*. The second is to be divided into two series, both viviparous, but one elongate or Bulimoid, the other flattened or Helicoid. The flattened shells (three genera) were originally, when known, regarded as species of *Helix*, and the fact that they are indisputably Achatinellid shows how difficult it is to correctly place fossil land snails, known from the shells alone. One of the *Helix*-like genera was first (Ancey, 1889) named *Tropidoptera*, but was renamed *Pterodiscus* by Pilsbry on the ground that *Tropidoptera* was a homonym of the earlier Coleopterous *Tropidopterus*. In my opinion, *Tropidoptera* is a valid name,[1] the difference in the ending sufficing to prevent homonymy. I have long been familiar with the genera *Ancylus* (Mollusca) and *Ancyla* (Hymenoptera), and although using both names, have never found the slightest confusion to occur in my mind.

The number of new Amastrine species described is large, indicating that the previous work on the Hawaiian mollusca, although voluminous, did not nearly exhaust the subject. The parts of the work most interesting to the general zoologist are the introductory chapter by Dr. Pilsbry, and the appendix compiled from Hyatt's manuscripts. According to Professor Hyatt the animals migrated from island to island in ancient times, and in some cases he even indicates the probable landing places of the immigrants and their subsequent migrations. Dr. Pilsbry, while fully agreeing with many of Hyatt's views, especially those on taxonomy, holds that while the snails did indeed migrate in various ways, it was on dry land. That is to say, the Hawaiian Archipelago was once a single large island, which presently divided into two, later into four, and finally reached its present condition. Good arguments are given in support of this hypothesis, and one can not help feeling that they would have convinced Professor Hyatt, had he lived to consider them and to go over all the evidence available at the present time. It is impossible in a review to adequately discuss this matter, but it is very evident that the whole subject is of the greatest interest to students of evolution, and when worked out from every point of view, may give us a definite idea of the time required for the evolution of species of various groups in the Hawaiian Islands. It is supposed that the large island Hawaii had only its most north-

[1] It is well to note that it has been omitted from the "Index Zoologicus."

ern part above water until just before the present stage in the development of the archipelago. This idea seems to receive support from the fact that the Achatinellidæ are almost confined to that part of the island, but it appears doubtful in view of the very large number of endemic Hymenoptera in Hawaii.

T. D. A. COCKERELL

Géologie du Bassin de Paris. Par M. PAUL LEMOINE. Paris. 1911. Pp. ii + 408; 137 figures; 9 maps.

Beginning with the classic "Description géologique des environs de Paris," by Cuvier and Brongniart, which reached a third edition as early as 1835, there have been a number of excellent general works on the geology of the Paris basin, that by Stanilas Meunier, first published in 1875, being perhaps the most used. Whatever the French do, they do well, and the Paris basin is such classic ground for the mesozoic and cenozoic geologist and paleontologist that the present work is of very great interest. That the book is well planned, well written and well illustrated is indeed but faint praise. M. Lemoine, who is vice-president of the Geological Society, has been working in the area for a number of years for the Geological Survey and is well equipped for the task of digesting the eight hundred odd memoirs treating of the area and combining their results with his own researches.

After three preliminary chapters devoted to an introduction for amateurs, and a historical, physiographic and tectonic discussion of the area, he plunges into the detailed geologic history of the basin, which commences with the Triassic. The Jurassic and Cretaceous of the Paris basin may be said to have furnished the standard for the world, as they have also so largely furnished the nomenclature, and these periods are treated at length. The very modern and altogether admirable work of the French paleontologists, particularly on the faunal facies and their correlation with particular sediments, is fully discussed and diagrammatically illustrated. Tertiary geology may be said to have been born in the Paris basin, even if Sir Charles Lyell was one of the wise men present at the birth, and here again the treatment is full and accurate. The Eocene in particular, because of the alternation of marine faunas with littoral, lacustrine and continental deposits containing land plants and terrestrial mammals, deserves to be and is rapidly becoming the world standard. The time is not far distant when the French étages will be used in all countries where men interest themselves in Tertiary history. Osborn has applied them with considerable success in his discussion of American mammal horizons and they lend themselves with equal readiness to discussions of the paleobotanical history of North America.

The book contains nine double-page maps and 137 text figures, every one of which is excellent, and will prove a most useful traveling companion for visiting geologists. The author is to be warmly congratulated, and it is to be hoped that American students will not only read the book, but try to imitate its method in their own geological writing.

EDWARD W. BERRY

JOHNS HOPKINS UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

THE opening (January) number of Vol. 14 of the *Transactions of the American Mathematical Society* contains the following papers:

F. N. Cole: "The triad systems of thirteen letters."

H. S. White: "Triple systems as transformations, and their paths among triads."

G. D. Birkhoff: "Proof of Poincaré's geometric theorem."

S. Lefschetz: "On the existence of loci with given singularities."

B. H. Camp: "Singular multiple integrals, with applications to series."

Oswald Veblen: "Decomposition of an n-space by a polyhedron."

C. N. Moore: "On convergence factors in double series and the double Fourier series."

Virgil Snyder: "Algebraic surfaces invariant under an infinite discontinuous group of birational transformations. Second paper."

N. J. Lennes: "Note on Van Vleck's non-measurable sets."

T. H. Gronwall: "Some asymptotic expressions in the theory of numbers."

H. H. Mitchell: "Determination of the finite quaternary linear groups."

L. S. Dederick: "On the character of a transformation in the neighborhood of a point where its Jacobian vanishes."

The January number (Vol. 19, No. 4) of the *Bulletin of the American Mathematical Society* contains: Report of the October meeting of the society, by F. N. Cole; Report of the October meeting of the San Francisco Section, by T. M. Putnam; Report of the Cambridge meeting of the International Congress of Mathematicians, Sections II.–IV., by Virgil Snyder; Report of the Münster meeting of the German Mathematical Society, by Virgil Snyder; "Shorter Notices": Hulburt's Differential and Integral Calculus, by D. D. Leib; Voigt's Theorie der Zahlreihen und der Reihengleichungen, by R. D. Carmichael; "Notes"; and "New Publications."

The February number of the *Bulletin* contains: Report of the sixth regular meeting of the Southwestern Section, by J. N. Van der Vries; "Some special boundary problems in the theory of harmonic functions," by T. H. Gronwall; "Note on Fermat's last theorem," by R. D. Carmichael; "Integral equations": review of Lalesco's Introduction à la Théorie des Equations intégrales and Heywood and Frechet's L'Equation de Fredholm et ses Applications à la Physique mathématique, by W. R. Longley; "An advance in theoretical mechanics": review of E. and F. Cosserat's Théorie des Corps déformables, by E. B. Wilson; "Shorter Notices": Fagnano's Opere matematiche, Heath's Method of Archimedes recently discovered by Heiberg, and Höfler's Didaktik des mathematischen Unterrichts, by D. E. Smith; Poincaré's Wert der Wissenschaft, by J. B. Shaw; V. and K. Kommerell's Spezielle Flächen und Theorie der Strahlensysteme, by E. B. Cowley; Horn's Einführung in die Theorie der partiellen Differentialgleichungen, by A. R. Crathorne; Forsyth's Lehrbuch der Differentialgleichungen and Poincaré's Calcul des Probabilités, by R. D. Carmichael; Lamb's Dynamical Theory of Sound, by E. B. Wilson; "Notes"; and "New Publications."

THE DIAGRAMS IN PROFESSOR THORNDIKE'S ADDRESS ON EDUCATIONAL DIAGNOSIS

Through a misunderstanding the lettering was not given for the diagrams in Professor Thorndike's vice-presidential address before the American Association for the Advancement of Science, printed in Science for January 24. They are here reproduced with the inscriptions.

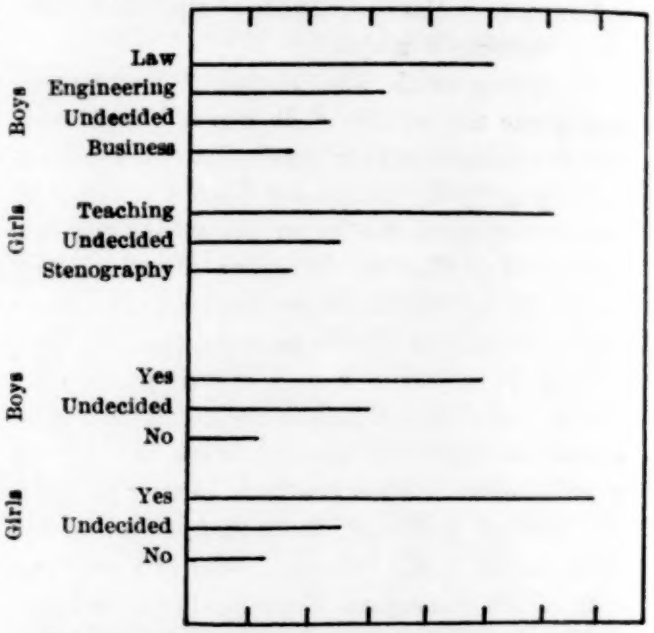

Fig. 4. The median expectation of length of stay in the New York City high schools, in the case of pupils who reported, at entrance to high schools, as shown at the left of the diagram, choice of occupation and intended length of stay.

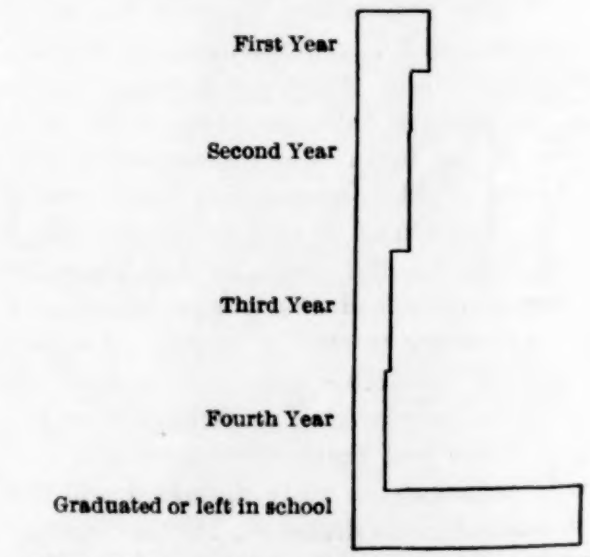

Fig. 5(*a*). The number of pupils, reporting themselves at entrance as expecting to complete the course, who leave in each successive year.

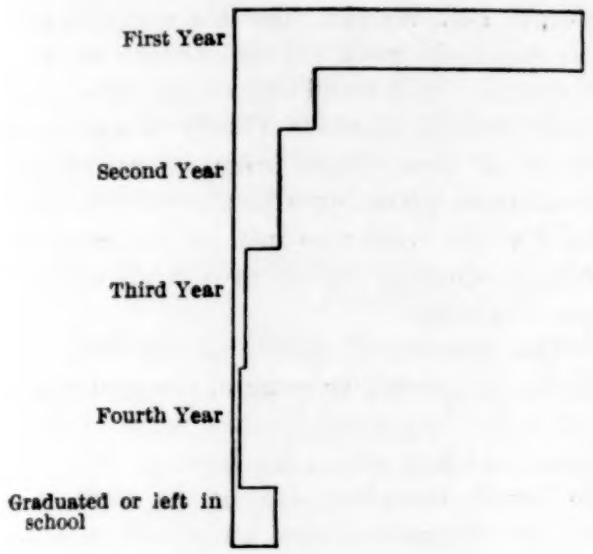

FIG. 5(*b*). The number of pupils, reporting themselves as expecting *not* to complete the course, who leave in each successive year.

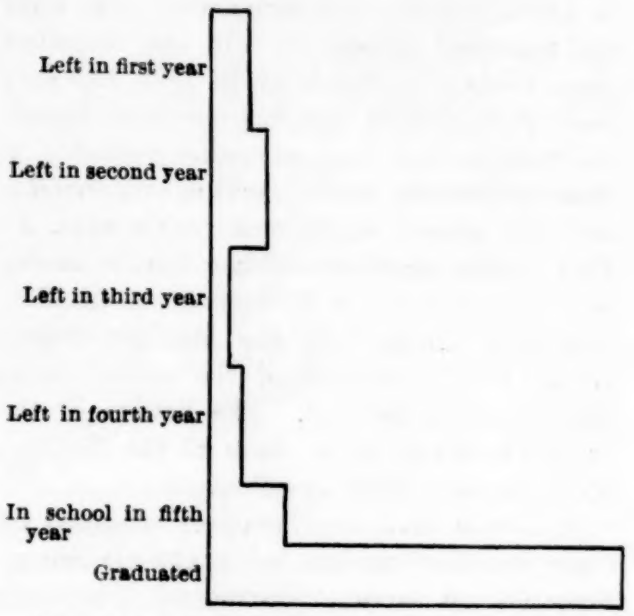

FIG. 8(*a*). The number of pupils, ranked in the top tenth for ability, who leave in each successive year.

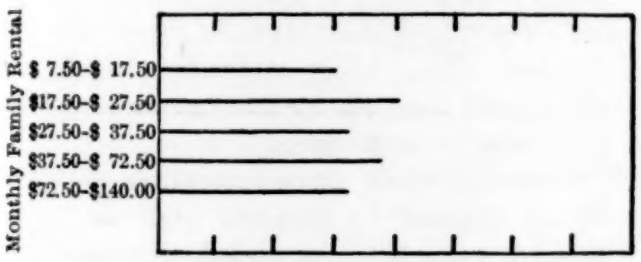

FIG. 6. The median expectation of length of stay in high school for pupils according to the family's monthly expense for rental.

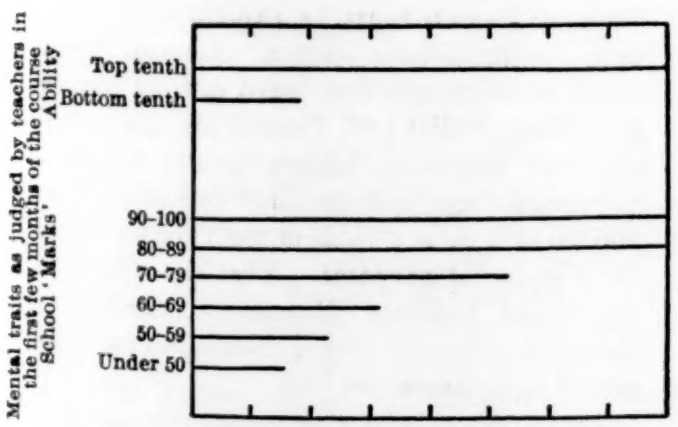

FIG. 7. The median expectation of length of stay in high school of pupils who during the first term were rated by their teachers as shown at the left of the diagram.

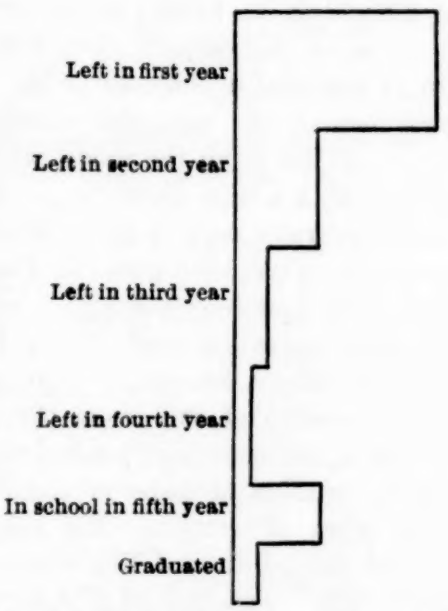

FIG. 8(*b*). The number of pupils, ranked in the bottom tenth for ability, who leave in each successive year.

SPECIAL ARTICLES

A WILD HOST-PLANT OF THE BOLL-WEEVIL IN ARIZONA

As cultivated cotton is the only plant thus far known to harbor the boll-weevil, the existence of another host-plant of these destructive insects may be worthy of notice. The plant

in question is not very well known, even from the botanical standpoint. It was described from Sonora by Asa Gray in 1855 as *Thurberia thespesioides,* and has also been identified with another Mexican species published in 1824 under the name *Ingenhouzia triloba.* But this generic name was preoccupied, an East Indian plant of another family having been named in honor of Ingenhousz in 1818. Nor is it certain that the Mexican *Ingenhouzia triloba* represented the same species that grows in Arizona. The flowers of the latter are white, while those of the Mexican species are described as yellow.

It is true that the characters supposed by Gray and Bentham to be of generic importance do not serve to distinguish *Thurberia* from *Gossypium.* The cells of the capsule show the same numbers, 3 or 4, as in many kinds of cotton, and some kinds of cotton imitate *Thurberia* in having a row of hairs on the inside of the carpel. But *Thurberia* offers more essential differences in the simple involucral bracts, the expanded corolla, and the absence of lint from the seeds, which are covered only with a thin, short fuzz. In view of these facts Gray's name may be retained.

Some attention has been given to *Thurberia* for the last three or four years in connection with the cotton-breeding work of the Department of Agriculture, because it seemed to be the nearest relative of the genus *Gossypium.* In external appearance and general behavior it is closely similar to some of the shrubby perennial types of cotton. The leaves are narrow and deeply divided like those of the so-called "okra" varieties of Upland cotton.

Until the present season the study of *Thurberia* has been limited to greenhouse and garden plants. The desirability of observing the habits and variations of the species in the wild state has been recognized, but all the localities where the plant was formerly known to exist were rather inaccessible. New localities on the slopes of the Santa Catalina Mountains not far from Tucson, Arizona, have been discovered recently by Professors Geo. F. Freeman and J. J. Thornber, of the University of Arizona, and one of these localities was visited a few weeks ago through the courtesy of Mr. Harold Bell Wright, who is a collaborator in the breeding work of the Bureau of Plant Industry. In a small canyon about two dozen large shrubby plants of *Thurberia* were found. Some of them might even be described as small trees, attaining a height of 10 feet, with hard woody trunks an inch in diameter. Six definite rings of annual growth are shown on one specimen.

The presence of punctures like those made by the boll-weevil on some of the seed capsules led to further search for the cause of the injury. At first only a few larvæ or pupæ could be found, embedded among the seeds of the nearly mature capsules, but finally a capsule containing an adult weevil was discovered by Mr. Wright. As all the plants had passed the flowering stage there was no means of learning whether the insect breeds in the floral buds as well as in the seed capsules, but it seems to be a habit of *Thurberia* to flower and fruit for only a short time in September and October. This habit of fruiting would not allow more than one or two broods of weevils to develop in each season.

Cotton is much more susceptible to weevil injury because it produces buds and bolls through a much longer period, thus providing facilities for breeding several generations of weevils. The fact that *Thurberia* is so much better adapted to escape serious injury may mean that it is the original host of the boll-weevil. Otherwise the infestation of *Thurberia* at Tucson must be explained by reference to prehistoric cotton cultures, which might have brought the weevil in from Mexico. The Pima Indians of Central Arizona cultivated an indigenous variety of cotton until a few decades ago, and the Hopi Indians of New Mexico still raise a little of their native cotton for ceremonial purposes. That the weevils in the Santa Catalina Mountains represent a recent importation from Texas seems altogether improbable.

As no cotton is now grown in the region of Tucson, the existence of weevils in the wild *Thurberia* is of no direct agricultural interest. But it is obviously desirable to know more of the habits and distribution of *Thurberia* in Arizona and adjacent states. A rapid exten-

sion of cotton culture is now going on in the Salt River Valley and other irrigated districts of Arizona and may bring the crop within the range of the native weevils.

O. F. COOK

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
December 18, 1912

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE Eastern and Central Branches of the American Society of Zoologists met in joint session at Western Reserve University, Cleveland, Ohio, December 30 and 31, 1912, and January 1, 1913, in conjunction with the American Association for the Advancement of Science and the American Society of Naturalists.

The following officers of the Eastern Branch were elected for the year 1913:

President—Raymond Pearl, Maine Agricultural Experiment Station, Orono, Me.

Vice-president—Alexander Petrunkevitch, Yale University, New Haven, Conn.

Secretary-treasurer—Caswell Grave, Johns Hopkins University, Baltimore, Md.

Additional Member of the Executive Committee—C. E. McClung University of Pennsylvania, Philadelphia, Pa.

These officers, in addition to R. G. Harrison (elected at the Ithaca meeting in 1910) and H. E. Jordan (elected at the Princeton meeting in 1911), will constitute the executive committee of the Eastern Branch for the ensuing year.

The present officers of the Central Branch continue until the next meeting of this branch.

The president of the society as a whole until the next joint meeting is Henry B. Ward, University of Illinois, Urbana, Ill.

The following persons were elected to membership in the American Society of Zoologists:

Eastern Branch—Ethel N. Browne, Princeton University; Esther F. Byrnes, Brooklyn High School for Girls; Wayland M. Chester; C. G. Crampton, Massachusetts Agricultural College; Edward C. Day; Alfred O. Gross, Bowdoin College; E. Newton Harvey, Princeton University; Davenport Hooker, Yale University; Otto F. Kampmeier, University of Pittsburgh; Henry Laurens, Yale University; Samuel C. Palmer; Edward E. Wildman, West Philadelphia High School.

Central Branch—Alexander MacGillivray, Cornell University; Gideon S. Dodds, University of Missouri; George A. Baitsell, Central College; W. C. Allee, University of Illinois; Aute Richards, University of Texas; Bertram G. Smith, State Normal School, Ypsilanti, Mich.; William Scott, University of Indiana; W. A. Willard, University of Nebraska; Addison Gulick, University of Missouri; Robert K. Nabours, Kansas Agricultural College; Mary T. Harmon, Kansas Agricultural College.

Elected to honorary membership, in recognition of his services to American zoology, Honorable James Bryce, British Ambassador to the United States.

Professor Nutting reported that the committee on zoological nomenclature, appointed by the Central Branch at its last meeting, had published its report in SCIENCE, December 13, 1912. The report was approved.

Professor S. A. Williston was elected a delegate at large to the Eighth International Zoological Congress at Monaco and requested to present the above report to the congress. The executive committee of the society was authorized to appoint an alternate.

The report of the treasurer of the Eastern Branch was presented as follows:

Receipts

Investments:	
From Raymond Pearl, Certificate of Stock No. 11,865 Industrial Savings and Loan Co	$150.00
Current funds:	
Received from R. Pearl	195.41
Interest on current funds	2.18
Dividend from stock	3.75
Dues from members	187.00
From treasurer Central Branch, for share of printing members' list	18.95
Total receipts in current funds	$407.29

Disbursements

Smoker, Princeton meeting	$7.00
Express on records from Orono, Me.	1.15
Postage and envelopes	15.90
Membership cards and receipt book	2.75
300 copies list of members ($45.00) with envelopes	46.35
Clerical assistance	5.98
Fees of notary and clerk of court	.77
Secretary's ticket, Hanover to Cleveland	36.10
Total disbursements	$116.00

Total receipts, as above	$407.29
Deduct total disbursements	116.00
Balance in current funds	$291.29

The report was approved by an auditing committee and accepted by the society.

The treasurer reported the failure of the Industrial Savings and Loan Co. in which the permanent funds of the Eastern Branch had been invested by a former secretary-treasurer. The treasurer, Professor J. H. Gerould, was appointed custodian of the claim on the fund so invested in order that legal processes incident to the change of treasurers might be avoided.[1]

Mr. Mayer offered resolutions upon the deaths of Professors T. H. Montgomery and Nettie Stevens. These were adopted by the society and the secretary instructed to publish them in SCIENCE and transmit copies to the families of the deceased members.

The society passed the following resolution by unanimous vote:

WHEREAS: It is essential to the advancement of the interests of American fisheries both at home and abroad that the commissioner of fisheries should be a man of the highest scientific attainments, as well as one of wide practical experience in the varied activities of the Bureau; therefore,

Be it Resolved, That the American Society of Zoologists, in session at Cleveland, Ohio, without expressing preference for any particular candidate, earnestly urge upon the President-elect, in the event that a change be made in the administration of the United States Bureau of Fisheries, the selection of a person for this office who is recognized as a trained zoologist, who has shown marked ability in the practical application of zoological methods and results, who is thoroughly familiar with the problems of American fisheries, and who possesses the ability so to organize and administer the affairs of the bureau as to bring the efficiency of its work to the highest development.

[1] At a meeting of the executive committee it was resolved that the funds of the society should for the present be invested only in savings banks or other institutions recognized as suitable depositories for trust funds and that the treasurers of the two branches should confer during the coming year and present recommendations for the investment of the society's funds not held for current expenses.

A committee consisting of E. G. Conklin (chairman), H. V. Wilson and A. G. Mayer was appointed to present this resolution to the President-elect.

After consideration and discussion of a motion by Professor C. C. Adams, the society voted to give the officers power to act for them in the support of both state and national legislation looking toward the protection and conservation of wild animals.

The following papers were presented at the meeting, either in full or by title:

ECOLOGY AND BEHAVIOR

A. S. PEARSE (University of Wisconsin): *The Beaches at Nahant, Mass.*

S. R. WILLIAMS (Miami University): *Notes on the Distribution of Thermobia domestica and Lepisma saccharina.*

These two *Thysanurans* are common in the house in Oxford in which I live, *Thermobia* in the attic and *Lepisma* in the cellar. The conditions of moisture and temperature are of course very different at the two levels. Daily records from July 11 to September 11, our hottest weather, gave the following results:

Cellar.—Highest record of maximum thermometer, 27° C., July 15. Lowest record of the minimum thermometer, 17° C., August 6. Average for two months, maximum, 22.7°; minimum, 19.5°.

Attic.—Highest record of maximum thermometer, 41° C., July 14. Lowest record of minimum thermometer, 11.5° C., August 4 and 5. Average for two months, maximum, 33.9°; minimum, 20.7°.

Animals of both species were kept in jars in the attic. It was found that when the temperature reached 40° C. or more, as it did July 14, 15, 24 and September 3, the *Lepisma* died, the last to succumb being young which hatched from eggs laid in the jars. To test this experimentally some *Lepisma* and *Thermobia* were heated over a water-bath in a flask with a thermometer passing through the cork. It is difficult to keep the animals from burning to death on the hot glass of the flask but an insulating material was put in the flask. All *Lepismas* died while the air-temperature of the flask was not beyond 40° to 43° C., while *Thermobia*—known in England as the "firebrat"—died at 47° to 48°. This indicates experimentally that *Lepisma* is unable to withstand the heat of an average summer in an attic at our latitude and hence does not go there, while *Ther-*

mobia endures such heat easily. The arrangement of the scales on the two forms is likely a part of the explanation of the distribution, since they lie flatter and less loosely on *Lepisma* than they do on *Thermobia*. Further observations are being carried on with reference to the moisture relations of the two forms in these habitats.

V. E. SHELFORD (University of Chicago): *An Experimental Study of the Reactions of certain Animals to Gradients of Evaporating Power of Air.* (Lantern.)

Millipedes, ground beetles and amphibians inhabiting moist forests react negatively, usually by turning back, when they encounter air of high evaporating power. The negative reaction usually begins after several trials of the air of high evaporating power. The reactions are similar when the evaporating power is due to current and when due to dryness, but in some cases they are more pronounced when it is due to higher temperature. Comparable animals from habitats where evaporation is great do not react sharply to the gradients used with the forest animals. Sharpness of reaction is not correlated with the length of time required to kill the animals with dry air.

J. W. SCOTT (Kansas Agricultural College): *The Viability of certain Cystocerci in Pigs and in Young Dogs.*

A series of experiments was tried to determine whether hogs are injured by feeding upon rabbits that are infected with the cysticerci of *T. serrata* and *T. serialis*. When corn is scarce it is a common practise for farmers in the western part of Kansas to feed jackrabbits to their hogs instead of corn. The intermediate host of *T. serrata* is the cottontail or common wild rabbit, but this parasite is occasionally found in the jackrabbit. In the vicinity of Manhattan out of a total of sixty-one rabbits examined during the winter of 1911–12, fifty-one (nearly 84 per cent.) were infected with cysticerci of *T. serrata*. The multiple cyst of *T. serialis* is found occasionally in the cottontail but is very common in the jackrabbit. This cyst may grow as large as a goose egg, and a single jackrabbit may have as many as half a dozen or more of these so-called "waterblisters" in various stages of development. Cysticerci from both species of tapeworms were fed to pigs weighing from seventy-five to ninety pounds, care being taken to prevent injury to the cysts before they were swallowed. Though a large number of cysticerci were fed, not a single tapeworm was found when the pigs were killed ten days later. When the same kinds of cysticerci were fed to young dogs from 90 per cent. to 100 per cent. were recovered in the form of young tapeworms. These experiments indicate a very high degree of specialization of the parasite with reference to its optimum environment.

A full account of these experiments, together with the time required for transformation, rate of development and effect upon the definitive host, will be published later.

C. C. ADAMS (University of Illinois): *Ecological Surveys.*

R. H. WOLCOTT (University of Nebraska): (1) *Some Aspects of Faunal Conditions in Western Nebraska.* (Lantern.) (2) *Biological Work in the Alkali Lakes of Cherry County, Neb.*

F. B. ISELY (Central College) (introduced by W. C. CURTIS): *Experimental Study of the Growth and Migration of Fresh-water Mussels.*

About 900 specimens, representing eleven species, of fresh-water mussels were tagged, weighed, measured, initial records taken and planted (returned to the stream or pond) by the writer in June, 1910. Many of these specimens were reclaimed, a number of times, and further records taken in 1910, 1911, 1912. Tabular results concerning the growth and migration of 122 of the specimens under observation are given.

A few points from the summary may be stated as follows:

1. Rate of growth is exceedingly variable.

2. The summer months are the growth months.

3. Lines of arrested growth may be called *rest rings*, the conspicuous ones being usually winter rest rings; occasionally, the rest rings may be two or more years apart, more often, however, several equally prominent rings may be formed in one year. Prominent rest rings are generally due to double prismatic and epidermal layers.

4. Under favorable environmental conditions there is little migration, especially among the Quadrulæ.

J. E. WODSEDALEK (introduced by A. S. PEARSE): *Some Results of Studies on Behavior and Starvation of Dermestidæ.*

NATHAN FASTEN and GEORGE WAGNER (University of Wisconsin): *The Behavior of a Parasitic Copepod, Lernæopoda edwardsii.*

This copepod is exclusively parasitic on the brook trout (*Salvelinus fontinalis*). During its free-swimming existence, not more than two days

at the most, it is strongly positive to intense illumination, whereas in light of low intensity it remains indifferent. On that account the copepod swims about close to the surface of the water throughout most of the day, with a spiral, dart-like motion, which in many respects is similar to the locomotion of the hunter ciliates. At night it sinks to deeper regions, due to its high specific gravity. These migrations are parallel with those of the brook trout and are, therefore, of great advantage to the life of the parasite. Increasing the temperature of the water, even to a degree that proves fatal, does not alter the reaction of the copepod to light. Chemicals also, such as sodium chloride, potassium chlorate, copper sulphate, calcium chloride, hydrochloric, sulphuric, tartaric and oxalic acids cause no reversal in the behavior of the copepod to light. In hydrogen-peroxide, magnesium sulphate, nitric and acetic acids indications of reversal were noticeable. The copepod reacts quickly to pieces of gill of the brook trout, but not at all to those of rainbow trout.

COMPARATIVE ANATOMY

Alexander Petrunkevitch (Yale University): *The Origin of Arachnida in the Light of Paleontological Evidence.*

Edwin Linton (Washington and Jefferson College): *Note on a Viviparous Distome.*

A distome (species not yet determined) found in the cloaca of a herring gull at Woods Hole, Mass., July 22, 1912, is unique in that the folds of the uterus contain ova in which active, ciliated larvæ (miracidia) have developed. The larvæ are conspicuous on account of the black pigment eye-spots. When the larvæ are set free from the parent worm each is seen to contain a single well-developed redia.

So far as the early stages of distomes have been observed in the marine invertebrates of the Woods Hole region they show a much less complicated life-history than that of the liver fluke. Sporocysts have been found (in certain mollusks and one annelid) some containing tailed, others tailless cercariæ. None were seen with rediæ. In those cases the redia stage is missing. In this distome from the herring gull the sporocyst stage is evidently omitted.

J. F. Abbott (Washington University): *Adaptations for Air-breathing in the Ocypod Crabs.*

F. D. Barker (University of Nebraska): *A Contribution to the Parasitic Turbellaria.* (Lantern slides and demonstrations.)

While working on the parasites of the fishes at the Bermuda Biological Station last summer two new species of parasitic turbellaria were found in the posterior sacculated portion of the intestine of the Bermudian holothurian *Stichopus*, both the black and the spotted varieties harboring the parasites.

In Bronn's "Klassen und Ordnungen des Thier-Reichs," 1908: 2574, forty-seven parasitic turbellaria are enumerated. These are classed as ecto- and ento-"Raumparasiten" and ecto- and ento-parasites; the latter are further divided into cœlomic, liver, kidney and intestinal parasites.

Parasitic turbellaria have been found in the following hosts: annelids, gephyreans, crustaceans, echinoids, holothurians, lamellibranchs and gastropods. Six species representing two genera have been reported for holothurians in general and one species, *Anoplodium schneideri*, has been described by Semper as occurring in the intestine of the holothurian *Stichopus variegatus*. With the exception of two species, the parasitic turbellaria of the holothurians occur in the body cavity. Not all of the holothurians examined were infected and in no case was the infection severe, twelve parasites being the largest number found in any one host. Both species of turbellaria were found in only one third of the animals examined, the larger elongated parasite being the more abundant.

The preliminary study of these turbellaria and a comparison with the known parasitic turbellaria shows them to be new and undescribed species and thus adds two more parasitic turbellaria to the list.

The detailed description of these forms will be published soon and will be followed by a further study of the histology and life history of these turbellaria with the hope of settling or giving new light and additional knowledge on a number of points concerning trematode and turbellarian morphology and histology which are now in dispute.

H. S. Pratt (Haverford College): *The Trematode Parasites of the Loggerhead Turtle.*

The parasites of the loggerhead turtle (*Caretta caretta*) have been studied from the Mediterranean Sea and the Gulf of Mexico. The two principal localities in the Mediterranean region where they have been collected are Trieste and Alexandria, where a large number of the turtles have been investigated for parasites by well-known zoologists from the time of Rudolphi to the present. In the most recent times Braun and

Looss have been the most active in this field. In the Gulf of Mexico three turtles have been investigated by Professor E. Linton and two by myself at the laboratory of the Carnegie Institution of Washington situated on Dry Tortugas. In all, nineteen species of trematodes have been found. Of these, nine species occurred in the turtles of the Gulf of Mexico, of which eight species live also in those of the Mediterranean Sea, only one species being peculiar to the former locality. Ten species which occur in the Mediterranean have not yet been obtained in the Gulf of Mexico, although the probability that some of them at least will be discovered there when a larger number of loggerheads are investigated is a strong one.

The most numerous trematode occurring in the Gulf of Mexico loggerheads is *Cymatocarpus undulatus,* several thousands of this species having been found in the duodenum of each of the five turtles investigated. This worm is apparently not common in the Mediterranean, not having been found at all off the Italian coast, although it has been taken a number of times at Alexandria. Among the individuals of this species in the duodenum of two of the turtles were many specimens of *Rhytidodes gelatinosus,* and in the intestine of two turtles was *Pachypsolus ovalis* many worms being present in one case and but two in the other. This last-named worm is the only species which is peculiar to the Gulf of Mexico, but its similarity to *P. irroratus* of the Mediterranean is so great that it is a question if it is not identical with it. The urinary bladder and rectum of two turtles contained many specimens of *Plesiochorus cymbiformis* and in the intestine of one turtle were two specimens of *Monostomum pandum,* while in another was found a single *Cricocephalus delitescens. Orchidasmus amphiorchis,* which is a very common worm in the Mediterranean, was found in only one turtle, and then in small numbers.

Further discussions of these trematodes with descriptions of those which are as yet insufficiently known will be published in the *Archives de Parasitologie.*

J. W. SCOTT (Kansas Agricultural College): *Note Concerning the Origin of the Introvert in Cirratulus.*

R. M. STRONG (University of Chicago): *Further Observations on the Olfactory Organs of Birds.*

In a study of the olfactory organs of birds, I found that the fulmar has very large olfactory lobes which are in immediate contact at their anterior ends with the posterior ends of the nasal chambers. There are no so-called olfactory nerves.[2] Since the paper which described that condition was published I have studied the olfactory organs of a number of species of the order to which the fulmar belongs, *i. e.,* the Tubinares. In all of these species similar conditions prevail, though the relative size and form of the olfactory lobes varies. The anterior turbinal is small in the Tubinares, but the other two turbinals are well developed. The posterior turbinal, to which most of the olfactory epithelium is apparently confined, is relatively large, especially in the storm petrels. The results of this work will be published later in connection with a study of the anatomy of the Tubinares.

A. W. MEYER (Stanford University): *Degenerative and Obliterative Changes in the Fetal Vessels and Ligaments.*

The observations which I desire to report were made quite incidentally in connection with other investigations. Hence in spite of the fact that a rather large series of animals were examined, they should not be considered as being exhaustive. The first matter of some interest in connection with these fetal structures is the entire absence of a ligamentum teretis hepatis and a ligamentum suspensorium hepatis in *Canis familiaris* and *Ovis aries* and probably also in bovines. In view of current descriptions and conceptions this seemed a rather surprising fact and I was further surprised that the statement also holds for old specimens of *Felis domestica* and *Cavia cabaya,* although in them the complete disappearance of these structures is comparatively slower. In *Canis familiaris* and *Ovis aries* both the vena umbilicalis and the ligamentum suspensorium hepatis disappear by the end of the second or third month of fetal life, as a rule, but they persist much longer in the other animals mentioned.

Since the umbilical vein disappears so early in both the dog and sheep it would of course be incorrect to say that a ligamentum teres was ever formed or existed in them. On the other hand, in cats, rabbits, guinea pigs, rats, etc., in which the degeneration is much slower and where it may be partial, a more or less temporary round hepatic ligament may hence be formed.

In the dog and the sheep the degeneration and regression of the umbilical vein and suspensory ligament of the liver take place *pari passu* as a rule, and they may even be somewhat interdependent or at least inter-related processes.

[2] See Strong, 1911, *Jr. Morph.,* Vol. 22, No. 3, pp. 619–660.

Moreover, the distal extremity of the degenerating umbilical vein after being freed from the abdominal wall may obtain a secondary attachment as a result of the formation of adhesions, to the parietal peritoneum usually somewhat more cranial to the umbilicus; to the liver or gall bladder; or most commonly to the extensive fold of extra-peritoneal fat lying ventrally in the median line between the processus xiphoideus and the umbilicus. Besides, such secondary attachments—which are, of course, purely temporary—may nevertheless retard the progress of the degenerative changes in the umbilical and omphalo mesenteric veins considerably. This is especially well illustrated in case of the omphalo mesenteric veins of the cat which are not rarely present still in cats one to two years old because they have come into more or less permanent relations to, and function as part of the systemic venous system. This rather surprising fact was especially well illustrated in two cats in which one of the omphalo mesenteric veins had obtained a secondary attachment to the apex of the bladder and arose in several vesicle veins. In these cases the omphalo mesenteric vein was patent throughout, filled with blood which could be forced into the superior mesenteric vein very easily by pressure and which was later expelled spontaneously by contraction in response to cooling of the vessels after death. A similar phenomenon was noticed in case of the umbilical vein of the cat, the distal degenerated and retracted extremity of which obtained a similar connection with the extra-peritoneal veins of the ventral body wall. It is evident, of course, that the establishment of such secondary vascular connections on part of the umbilical vein might and does materially affect the rate of regression, not only of the vein itself, but of the suspensory ligament as well. This is particularly true if, as is not infrequently the case in cats, a very large lymphatic vessel lying between the layers of the suspensory ligament extends parallel to its concave and free caudal border.

The extremely late disappearance of the omphalo mesenteric vessels in the cat not uncommonly observed is as remarkable as the early disappearance of the umbilical vein in the dog and sheep. Indeed it is not rare to find the omphalo mesenteric vessels persisting as fine fibrous strands which may contain no remnant of the lumen and which have obtained a secondary attachment elsewhere, in cats half a year to a year old.

The umbilical arteries which retract intra-abdominally instantaneously at the time of rupture of the cord in *Bos taurus* and *Ovis aries* were never found to have secured such a secondary attachment, but in *Canis familiaris, Felis domestica, Lepus cuniculus, Mus rattus* and *Cavia cobaya*, in which they remain attached to the abdominal wall at the umbilicus and become detached only one to two weeks *post natum*, their free ends obtain a firm secondary attachment to the apex of the bladder in the majority of cases. Yet they were never observed to come into relation to the systemic arterial system with their free ends or their degenerating trunks.

The early complete disappearance of the umbilical vein of the dog and sheep was due to a degeneration of its musculature and consequent absorption. These degenerative processes which in these animals were sometimes accompanied by a certain amount of connective tissue invasion never ended in the formation of a truly ligamentous structure, however. In the cat, rabbit and guinea-pig, on the contrary, such a transformation into connective tissue of at least the distal portion of the umbilical vein was not uncommon.

In case of the umbilical arteries in any of these animals two methods of transformation were observed. The connective tissue which displaced the musculature arose either of subintimal or adventitial origin. In the first case it formed between the intima and the elastica interna when present, which was usually the case, while in the second case it displaced and invaded the media from without. However, since there is a great deal of connective tissue between the fasciculi and concentric layers of muscle fibers of fœtal vessels, both these processes may also be accompanied by proliferation of the inter-fascicular, intra-medial connective tissue. Moreover, it is evident that these processes may all be combined. Nevertheless, this was usually not the case and instances were observed in which the musculature was plainly degenerating and being displaced only from within, for the outer layers were well preserved, while in other cases exactly the opposite conditions were present.

No evidence whatever for the origin of connective tissue from endothelium was obtained and the initiation of degeneration and transformation were apparently independent of thrombus formation, but apparently not of the presence of non-coagulated blood in the lumen of the vessel.

L. B. Walton (Kenyon College): *The Anatomy of the North American Land Planarians.*

A. M. REESE (West Virginia University): *The Histology of the Enteron of the Alligator while Hibernating and while Feeding.*

The chief object of this investigation was to determine the effect of hibernation upon the digestive tract of the alligator, and incidentally to study the histology of these structures, which has not, so far as the author is aware, been done before in any detail.

The material used was taken from young animals at the end of a feeding period of about five months, and towards the end of the hibernating period after fasting for four or five months.

The regions of the enteron that were studied were as follows: the tip and base of the tongue; the anterior and posterior regions of the roof of the mouth; the anterior and posterior regions of the esophagus; the cardiac, fundic and pyloric regions of the stomach; the anterior, middle and posterior regions of the small intestine; the anterior and posterior regions of the rectum.

Since the work was started at the end of the hibernating period the tissues of that period were studied and drawn first.

The only difference between the structure of the tip of the tongue during hibernation and during the feeding season is that the scaly epithelium with which it is covered is somewhat thicker and more compact in the former than in the latter condition, though even this difference may have been due to differences in the ages of the animals used. The base of the tongue differs from the tip in having a thicker epithelium and in having compound, tubulo-alveolar glands. These glands in the hibernating animal have many more alveoli than in the feeding animal, though this, again, may have been due to the difference in age.

The lining of the roof of the mouth is essentially the same as that of the tongue. The glands are found only in the posterior region. The slight differences in the papillæ here found may easily be due to the difference in age.

The esophagus shows the usual layers for that region. Its epithelium is partly ciliated in the anterior part. The muscularis mucosa is very scant in the anterior region. The only difference between the two stages is that in the feeding the muscularis mucosa in the anterior region is much more strongly developed than in the hibernating stage; and in the former the nuclei are not arranged in two zones as in the latter.

The stomach has the usual layers, and has essentially the same structure in the three regions studied, except that the wall in the fundic region is much the thickest, due mainly to the great thickness of the middle muscular layer. Only one kind of cell is found in the gastric glands. No difference is to be noted between the hibernating and the feeding conditions.

The chief peculiarity of the small intestine is the apparent entire absence of the submucosa. Goblet cells are also wanting. The greater diameter of the anterior region is due both to the greater diameter of the lumen and to the greater thickness of the walls. The middle and posterior regions have about the same diameter, though the mucosa becomes thinner and less complicated caudad. There is practically no difference between the hibernating and feeding stages.

The anterior and posterior regions of the rectum have essentially the same structure. No difference can be seen between the hibernating and feeding conditions.

The differences, then, between the digestive tracts of the hibernating and feeding animals are so slight that it may be said that hibernation has practically no effect upon the enteron of the alligator, at least in captivity.

F. W. CARPENTER (University of Illinois): *Methylene Blue Preparations of Nerve Endings in Cranial Autonomic Ganglia.* (Demonstration.)

H. L. BRUNER (Butler College): *Jacobson's Organ and the Respiratory Mechanism of the Urodeles.*

In the amphibians the relation between respiration and smell is complicated by the peculiar nature of the respiratory mechanism, which includes an apparatus for closing the nasal passage. In this group Jacobson's organ, when present, is a blind sack or groove opening into the general olfactory cavity. According to the theory of Seydel (1895) it is stimulated by odorous material which passes through the choana from the mouth. The organ in question has been recognized in the *Anura* and *Salamandrida* and among the lower urodeles, in *Cryptobranchus* and *Amphiuma*. It is wanting in *Proteus* and *Necturus*.

Among the amphibians studied, the organ of Jacobson is present in all forms in which the expiratory media pass through the nose in adult life. In *Necturus* and *Proteus* access to the nasal cavity from the mouth is prevented by a mechanical breathing valve at the choana and the organ

of Jacobson is wanting. Seydel assumed that this simple condition of the olfactory organ of *Necturus* is a primitive one, but it seems more probable that the organ has degenerated on account of the presence of the choanal valve.

J. F. Daniel (University of California): *The Endoskeleton of Heterodontus francisci.*

F. D. Barker (University of Nebraska): *The Parasites of the Muskrat.* (Lantern slides and demonstration.)

With the exception of a brief note by Leidy, 1888: 126, there is no reference to or description of the parasites of our common muskrat.

A recent examination of 27 muskrats trapped along the Loup River in Nebraska revealed a heavy parasitic infection. Over 600 worms were found, including trematodes, cestodes and nematodes. Seven species of trematodes, one species of cestode and two species of nematodes were represented.

The work on the trematodes which is now completed shows all seven species to be new and heretofore undescribed with one possible exception, and in that case there is only the meager description of Leidy referred to above.

The large number of different and new species of parasites which occur in the muskrat but emphasizes the virgin and fertile nature of the field of parasitology for the investigator and also emphasizes the need and the value of a thorough survey of the parasitic fauna of our common animals by states, or better, by smaller units of area.

The description of one of the trematode parasites of the muskrat has been published and the descriptions of the other six species will appear soon.

R. J. Gilmore (introduced by F. C. Waite): *Variations in the Pelvic Girdle of Diemyctylus viridescens.*

W. E. Sullivan (introduced by F. C. Waite): *Zones of Growth in the Skeletal Structures of Pseudopleuronectes americanus (Walb).*

W. A. Willard (University of Nebraska): (1) *The Epidermal Sense Organs of Anolis carolinensis.* (2) *A Case of Complete Twin Formation in Squalus acanthias.*

COMPARATIVE PHYSIOLOGY

Max Morse (Trinity College): *The Rôle of Phagocytosis in the Process of Involution.*

Involuting organs, such as the tail of the anouridan larva, their gills, etc., have been described by Metchnikoff and others as atrophying through phagocytosis. Metchnikoff believed that the phagocytes arose from the muscle cells themselves, but sections through organs at the time of degeneration show no mitoses in the muscle cells. Others, such as Mercier, believe that the leucocytes act as phagocytes and cause the breaking down of the organs, but differential counts of blood from young larvæ, those during metamorphosis and from adults show no correlations which would indicate that polynuclear leucocytes, basophiles, eosinophiles, large or small mononuclear leucocytes play any rôle in the process. The process of atrophy here is similar in essential respects to the involution of the uterus in mammals, to the degeneration of the individuals of the bryozoan colony, etc., where the process is doubtless autolysis and experiments are in progress, which seem to show that this is the case in the metamorphosing amphibian larva.

A. G. Mayer (Carnegie Institution): *Some Effects of Ions upon the Movements of Marine Animals.*

J. F. Abbott (Washington University): *Reactions of Fiddler Crabs to Salt Solutions.*

H. M. MacCurdy (Alma College): *Some Effects of Sunlight on the Starfish Asterias forbesii.*

S. O. Mast (Johns Hopkins University): *The Reactions of Spondylomorum to Light, with Special Reference to the Question of Changes in the Sense of Reactions.*

H. W. Rand (Harvard University): *Reactions of the Tentacles of Sagartia luciæ to Tactile Stimulation.*

The reactions of tentacles of *Sagartia luciæ* to tactile stimulation vary from a minimum reaction consisting of a slight longitudinal contraction in a narrow zone at the level of the point stimulated, to a maximum contraction of the entire tentacle. Occasionally the response extends to neighboring tentacles or even involves the entire animal. In a certain animal at a certain time the degree of the response varies with the intensity of the stimulus. But in the same animal at different times, or in different animals at the same time and under similar conditions of experimentation, the reactions show great variation.

Two distinctly opposed physiological conditions were noted. In the one condition (designated as positive) the distinctive feature of the reaction is a bending of the tentacle at the point stimulated and toward the stimulated side. In this condition

the responses are, in general, like those involved in taking food. The distinctive feature of the second condition (negative) is a bending of the tentacle at the point stimulated but away from the stimulated side. The positive and negative conditions are not necessarily correlated with hunger and satiety, nor with the state of the medium in which the animal lives, nor with fatigue. While external conditions remain as nearly as possible constant, the animal may abruptly change back and forth from one condition to another. The reactions, therefore, while influenced by external conditions, depend essentially upon an internal physiological complex.

A. J. GOLDFARB (College of City of New York): *On the Effects of Changes in Density of Sea Water upon Growth and Regeneration.*

G. H. PARKER and E. M. STABLER (Harvard University): *Taste, Smell and Allied Senses.*

The statement that the stimulus for smell is material in the form of gas and for taste is material in solution is partially incorrect, for both sense organs are normally stimulated by solutions. It has been recently shown that fishes respond to their food by smell and taste much as air-breathing vertebrates do. What seems to be the chief difference between smell and taste is that the olfactory organs are stimulated by very dilute solutions, the organs of taste only by much stronger ones. To get some quantitative statement of this difference, the strength of the stimulating solution producing the minimum stimulus was determined for a substance that had both smell and taste. The substance tested was ethyl alcohol. In preliminary tests the following results were obtained. The weakest dilution that would stimulate the mucous surfaces of the mouth was a 15 mol. solution (aqueous). The weakest dilution that called forth the sweet taste when applied to the tongue was a 2 mol. solution (aqueous). The weakest dilution that could be smelled was 1/200,000 mol. (in air). Thus the olfactory apparatus responds to a dilution about 400,000 times greater than that for taste.

G. G. SCOTT (College of City of New York): *The Effect of Fresh Water upon Fundulus heteroclitus.*

It is now well established that *Fundulus heteroclitus* is found in both sea water and fresh water. The fact that few survive rapid transference from salt to fresh water while greater numbers survive gradual transference shows that we are here concerned with another application of DuBois Reymond's law of stimulation. Out of a lot of ten *F. heteroclitus* transferred from salt to fresh water, the present author kept one fish alive in fresh water for sixty days. When the caudal fin is removed at the time the fishes are transferred from salt to fresh water regeneration of new caudal fin tissue takes place, although in a month's time the amount is not as great as in sea water. Of greater interest from the point of view of the mechanism of adaptation are the results of experiments in which individual records were kept of changes in weight made at a number of intervals after immersion of *Fundulus* in fresh water. In some cases all members of a lot of fishes died soon after transfer. In each case a rapid increase in weight was noted. In other cases certain individuals gain weight rapidly and die. Other individuals of the lot after an initial gain in weight follow this with slight gains and losses—the net results in these survivors being a weight less than normal at the end of the experiment. The experiment apparently illustrates the power of *Fundulus heteroclitus* to change the organization of the limiting membranes and other structures of the body to the end that the fish becomes adapted to fresh water, a medium of very low osmotic pressure as compared with sea water.

MAX MORSE (Trinity College): *Factors Involved in the Metamorphosis of Amphibia.*

A. G. MAYER (Carnegie Institution): *The Vital Limits of Reef Corals in Respect to Temperature.*

S. O. MAST (Johns Hopkins University): *Thirteen Hundred Generations in Didinium without Conjugation.*

A. J. GOLDFARB (College of City of New York): *On a New Method of Grafting Embryos in Large Numbers.*

EMBRYOLOGY AND DEVELOPMENT, CYTOLOGY

ALBERT KUNTZ (University of Iowa): *The Histogenesis of the Cranial Sympathetic Ganglion in the Pig.*

H. L. CLARK (Harvard University): *Ontogenetic and Localized Stages in Ophiurans.*

C. M. CHILD (University of Chicago): *Senescence and Rejuvenescence in Planaria velata.*

B. M. ALLEN (University of Wisconsin): *Some Methods of Embryological Technique.* (Accompanied by a demonstration.)

CHARLES ZELENY (University of Illinois): *Experiments on the Control of Asymmetry in Young Serpulids.*

Caswell Grave (Johns Hopkins University): *The Egg of Ophiura, its Yolk Content and Course of Development.*

G. T. Hargitt (Northwestern University): *The Oogenesis of Campanularian Hydroids.*

The egg cells of *Campanularia flexuosa* arise from the basal half of an ordinary epithelial cell of the entoderm, the distal half remaining an epithelial cell; or else they arise by the transformation of an entire entoderm cell in the pedicel of the gonophore. In either case the cell so produced is transformed directly into an egg cell without any divisions occurring. Since the entodermal epithelial cells from which the egg cells arise are not different from the neighboring cells which retain their epithelial function, and since the distal half of a divided cell remains in position lining the cœlenteric cavity and retains its function (the proximal half forming an egg cell), there is clearly no continuity of the germ-plasm, the egg arising from a so-called somatic cell.

Coincident with the marked and rapid growth of the egg the nucleolus (which is partly chromatin) breaks up into many fragments of various sizes and shapes, and becomes highly vacuolated. At the same time there appear small granules in the cytoplasm against the membrane of the germinal vesicle, and also similar small granules are present inside the membrane; these are found to be nucleolar fragments, some of which are chromatic in character. In addition to these indications of the escape of chromatin from the germinal vesicle there are currents in the cytoplasm extending away from the nucleus, as shown by the arrangements of the cytoplasmic granules. These currents cease when the nucleolus has entirely disappeared from the nucleus through fragmentation and dissolution, and this period is also the end of the growth period of the egg. The nucleolar material which has left the nucleus goes to form the yolk spherules of the egg.

During the growth of the egg the nuclear reticulum has remained unchanged by the modifications and transformations of the nucleolar substance which has been dissolved and cast into the cytoplasm. When the nucleolus is practically all gone and the growth of the egg has ceased the chromatin of the reticulum produces the chromosomes of the polar spindle, which are ten in number. In spite of the extensive chromatin emission, coming from the dissolving nucleolus, the chromatin remaining in the nuclear reticulum is still more than is necessary for the formation of the chromosomes, and the greater part of it escapes into the cytoplasm in the form of granules when the germinal vesicle breaks. That which is not thus scattered forms the chromosomes.

To account for the large amount of chromatin which escapes from the nucleus there must be a formation of chromatin within the nucleus during the growth period of the egg, and the nucleolus is conceived to be the place where the chromatin is produced and transformed for the different functions it has to perform. In this origin of new chromatin, and in the extreme dissipation of chromatin during and after growth, it is believed that we have strong evidence against the continuity of chromatic material, and hence of the chromosomes. The chromatin is a metabolic product changing and transforming as all other constituents of the living cell.

J. F. Abbott (Washington University): *The Blood Cells and their Respiratory Pigment in Thallasema.*

H. E. Jordan (University of Virginia): *A Comparative Study of Mammalian Spermatogenesis with Special Reference to the Heterochromosomes.*

Among the forms examined, including mongoose, cat, squirrel, pig, rabbit, white mouse, sheep, horse, mule, bull and dog, heterochromosomes are lacking in the male germ-cells of the first five, and present in the remainder. The available evidence favors more the interpretation in terms of a bipartite or compound X-element than of an associated X and Y group (idiochromosomes).

In view of the fact that heterochromosomes have recently been reported in man and rat (Guyer), armadillo (Neuman and Patterson), guinea-pig (Stevens) and opossum and bat (Jordan), the evidence indicating similar elements in the above enumerated group of six common mammals would seem to warrant the conclusion that sex-chromosomes are very generally present in mammals. Universality of presence seems vitiated for the present by the fact that in another group of five mammals such elements seem unquestionably lacking. It might be assumed that such elements are actually present in the male germ-cells, but so small or labile as to elude detection by present methods, or not presenting the usual morphology of heterochromosomes during the prophase stages. The unmistakable presence, however, of a "split-accessory" in the female germ-cells (primary oocyte) of the cat, as recorded by Winiwarter and Sainmont, and the absence of

any *X*-element in the male, suggests very forcibly that sex-chromosomes are present in all mammals, generally in the male, exceptionally in the female. The same end would be attained, that of numerical sex-equality, whether present in the one or the other sex. If this hypothesis can be further sustained, it would seem cogently to reinforce the evidence for an essential sex-determining function of heterochromosomes. Interpreted in terms of Mendelian heredity-formulæ, in those mammals in which an *X*-element is present in the male, the female sex is homozygous, the male heterozygous. The facts would seem to fit the hypothesis that the accessory chromosome acts as a deterrent to the development of maleness; or more accurately, and in keeping with a quantitative interpretation of sex in the last analysis, the accessory with its egg-homologue (two *X*-elements) inhibits male sex development; the single egg-homologue in males being insufficient to counteract the male tendency, thus giving origin to male individuals.

The complete paper will appear in a Carnegie Institution publication.

A. W. MEYER (Stanford University): *Observations on Giant Cells in Hemal Nodes and Accessory Spleens.*

M. F. GUYER (University of Wisconsin): *Remarks on the "X" Element in Fowls.* (Demonstration.)

A reexamination of old material and a further study of new material from the Langshan cock abundantly confirms the original finding of an accessory chromosome which passes undivided to one pole of the spindle in the division of the primary spermatocyte. The element in question was demonstrated through the microscope to members of the society.

T. S. PAINTER (introduced by A. PETRUNKEVITCH): *Spermatogenesis in Spiders.*

A cytological difference has been found in the spermatogenesis of the dimorphic males of the jumping spider, *Mævia vittata.* The "gray variety" contains two supernumerary chromosomes which do not divide in the last spermatogonial division. During the first maturation division these bodies show a definite association for the accessory chromosome and pass with the latter to one pole of the cell at this time. For this reason these supernumeraries have been called "ctetosomes" (implying, are the property of, are associated with, some other body). During the second maturation division the accessory chromosome divides, but this could not be certainly determined for the "ctetosomes." As a result of the unequal spermatogonial division the sperm are of three types: (1) sperm which bear the accessory chromosome and "ctetosomes"; (2) sperm which bear the accessory chromosome only; (3) sperm which bear neither of these elements.

The "tufted variety" of male lacks the "ctetosomes" although a supernumerary chromosome may be present. This body shows no relation for the accessory chromosome and seems to follow no definite law of distribution. Hence it was called a "planosome" (indicating that it wandered through the cell mitoses).

"Planosomes" have been found in many families of spiders. Most abundant in *Amaurobius sylvestris,* which may carry as many as seven "planosomes" and three "ctetosomes."

The females of *Mævia vittata* carry two doses of the accessory element.

G. L. KITE (introduced by OSCAR RIDDLE): *Studies on the Physical Properties of the Structural Components of Protoplasm.*

MARY T. HARMON (introduced by J. W. SCOTT): *The Character of Cell Division in the Sex Cells of Tænia teniæformis.*

GENETICS

H. H. NEWMAN (University of Chicago): *Five Generations of Congenital Night-blindness in an American Family.*

During the past two years the writer, in colaboration with Miss E. L. Brown, a former student of his and a member of the affected family, has obtained data concerning 76 individuals belonging to a family connection showing a peculiar type of hereditary night-blindness. The family originated in North Carolina, but now resides in Texas. The defect is present through life and is usually, though not always, associated with myopia and strabismus. This complex of optic affections is inherited from affected men through unaffected daughters to some of the grandsons, and in no other way. Thus, as in the case of color-blindness, the character gains expression only in alternate generations. The mechanism underlying this mode of inheritance is probably closely allied to that described by E. B. Wilson as underlying the inheritance of white eyes in *Drosophila.*[3] According to this scheme the factor for night-blindness is contained in the *X* chromosome, which Guyer has described for man. Frequently associated with night-blindness, but neither sex-limited nor

[3] See *Journ. Morph.,* Vol. 22, No. 1, p. 96.

linked with the night-blind complex is a fairly common optic disease known as pterygium. The factor for this defect is evidently not carried by the X chromosome.

F. E. Lutz (American Museum of Natural History): *The Offspring of Certain Wing-mutants X Normal Drosophila and Sexual Dimorphism.*

H. S. Jennings (Johns Hopkins University): *Biparental Inheritance and the Question of Sexuality, in Paramœcium.*

A. M. Banta (Station for Experimental Evolution): *Selection within Pure Lines in Daphnia.*

Conceiving that the modification of a physiological character by selection within a pure line may perhaps be more readily brought about than the molding of a structural or morphological change, if either is to be accomplished, selection within pure lines in *Daphnia* was attempted on the basis of a purely physiological character. The character chosen was the reaction time of the young daphnids under precise conditions to a definite intensity of light.

Selections were begun in 13 lines after they had been reared under laboratory conditions as pure lines, reproducing parthenogenetically, for from six to eight generations. The selections have continued through from 19 to 25 generations in the various lines with a + strain, a strain selected for greater reactiveness to light, and a — strain, selected in the reverse direction, in each pure line. Comparing corresponding + and — strains by broods there is considerable variation in the mean reaction time, the + strain sometimes having the lower reaction time, *i. e.*, being presumably the more reactive to light, and sometimes, *though less often*, the — strain having the lower reaction time. The general trend of the results is better shown by throwing the data into larger groups. Comparing all the + strains with all the — strains by two-month periods for the whole time during which the selection has continued it has been found that during two (the first and the third) of these five two-month periods the + strains had a higher general average reaction time by an average of 12 seconds. During the other three periods (second, fourth and fifth) the — strains had a higher reaction time by an average of 43 seconds. The general average reaction time of all the individuals of all the + strains for the entire period after selection began (944 individuals) has been 386 seconds and the corresponding average for the — strains involving 1,013 individuals has been 410 seconds, 29 seconds or 8 per cent. more than for the + strains. Compared with the + strain the average reaction time has been significantly larger (*i. e.*, 2½ or more times the probable error) in the — strain in five of the lines. In another of the lines, however, an almost equally large difference in the reverse direction occurred.

Raymond Pearl and H. M. Parshley (Maine Agricultural Experiment Station): *The Experimental Modification of the Sex-ratio in Cattle.*

A. F. Shull (University of Michigan): *The Life-cycle and Sex in Thysanoptera.*

Oscar Riddle (Carnegie Institution): *Chemical and Energy Differences between the Male- and Female-producing Ova of Pigeons.*

L. J. Cole and F. J. Kelley (University of Wisconsin): *The Inheritance of Certain Color-patterns in Pigeons.*

H. H. Newman (University of Chicago): *On the Unique Mode of Inheritance in the Nine Banded Armadillo.*

The study of 140 female armadillos and their offspring has shown that minute personal peculiarities, such as double, half and split scutes, double and fused bands, are strongly inherited though interchangeable in their inheritance. All of the 63 mothers that show any of these peculiarities have one or more affected offspring. About half of the unaffected mothers have affected offspring, due evidently to affected fathers, since the characters are in no way sex-limited. These characters appear sometimes unilaterally, sometimes bilaterally in the mothers. When unilateral in the mother it may reappear bilaterally in some of the offspring and unilaterally in others; or it may appear in some and be entirely wanting in others of the same set of quadruplets. When the character appears unilaterally in several of the offspring it is usually distributed so as to produce mirrored image effects between pairs or between the individuals of a pair. The characters appear to have been distributed among the four fœtuses by means of a series of dichotomies of some inheritance factor, which can be best conceived of as having a material and highly localized existence—in short as a Weismannian determiner. The facts may, however, be interpreted equally well, and perhaps more acceptably, by taking into account that the cells of all the fœtuses are heterozygotic in origin and that the appearance of an inherited character or its failure to appear may be due to varying degrees of success in the struggle for

supremacy between maternal and paternal inheritance forces.

OSCAR RIDDLE (Carnegie Institution): *Different Degrees of the Sex Character Indicated by the Sex Behavior of Some Female Pigeon Hybrids.*

L. J. COLE (University of Wisconsin): *Two Yellow Mutants of the Common Meadow-vole.*

H. D. GOODALE (introduced by A. M. BANTA): *Additional Cases of Ovariotomy in Fowls and Ducks.*

The development of male characters in three female birds following the removal of the ovary has been previously reported. It is the purpose of this note to present, very briefly indeed, additional data obtained from experiments made the past season on birds ranging from five to twenty weeks of age at the time of the removal of the ovary.

Ducks.—Fifteen females were operated on, not including a few that died as the result of the operation. In three of these cases, owing to hemorrhage, it was impossible to remove all the ovary. These three birds did not assume any male characters. In the twelve remaining cases, the birds all began to develop the male plumage, but after a short time three individuals reverted to their original type. The cause of this reversion became apparent, when, on examination, it was found that the ovaries had partially regenerated. The remaining nine individuals have continued to acquire the male's plumage, that is, as the female feathers drop out they are replaced by feathers like those of the corresponding male. In five of these last cases it has been ascertained by a second operation that the ovary was completely removed. Although in several of these cases, the transformed females are, externally at least, almost perfect replicas of the corresponding male; nevertheless, the voice remains that of the female even in those cases where the adult voice was acquired several weeks after the operation.

Fowls.—Operations were performed on 18 birds. Four disappeared, four are still too young to show male characters and in three cases only part of the ovary was removed. These last did not assume any male characters. In all the remaining cases but one the male habit is developing in its en tirety, viz., plumage, spurs, comb and wattles. The one exception noted that reverted to the female type after a time was due, as examination showed, to the regeneration of the ovary.

Summing up all these cases in both kinds of birds, there is a total of 24 individuals which, at the time of writing, have assumed male characters following ovariotomy.

JOHN DETLEFSEN (introduced by J. H. GEROULD): *Genetic Studies on a Cavia Species Cross.*

O. L. JONES (introduced by L. J. COLE): *Some Results of a Study of Pigmentation in Pigeons.*

MISCELLANEOUS TITLES

JACOB REIGHARD (University of Michigan): (1) *On the Breeding Behavior of the Log Perch (Percina caprodes).* (2) *An Instance of Locality Memory in the Woodchuck.*

ELIZABETH M. DUNN (Nelson Morris Laboratory of Medical Research): *The Sensory Innervation of the Developing Hind Leg of Rana pipiens.*

F. L. LANDACRE (Ohio State University): *A Comparison of the Cerebral Ganglia of Ameiurus, Lepidosteus and Rana in Embryonic Stages.*

W. B. WHERRY (introduced by H. McE. KNOWER): *Experimental Studies on Ameba.*

M. A. BRANNON (University of North Dakota): *An Examination of the Conditions of Life in Devils Lake.*

This report deals with experiments in acclimatizing fish at the North Dakota Biological Station, on the shores of Devils Lake, North Dakota. The experiments extended over a period of four summer seasons. The large-mouthed black bass, the sucker, bullhead, pickerel, yellow perch, steel head trout and rainbow trout, furnished the material for the experimental work. Their ages varied from fish that were only a few months of age to those that were several years old. The Devils Lake waters are about one and two hundredths per cent. saline with the three salts, sodium sulphate, magnesium sulphate and sodium chloride, representing the major part of the saline material in the water. None of these salts, in the percentage existing in Devils Lake waters, are toxic for fish, hence it seemed probable that it was a physical rather than a chemical condition which was inhibiting the fish life which I placed in the cultures of Devils Lake water. Proceeding on that hypothesis the fish were placed in waters that very gradually changed from the chemical composition of the sweet water, from which the fish came, to the percentage of salinity of that in Devils Lake.

The factors of heat and gas composition were found very important, as shown from the readings which were determined during the progress of the experiments.

Devils Lake was the home of millions of pickerel prior to the year 1888. Carloads were shipped away regularly each week during the winters when they were so abundant.

A series of dry years caused a lowering of the level in some fresh-water lakes formerly connected with Devils Lake. This in turn was followed by the drying up of the stream connecting Devils Lake with sweet water associates. These latter had served as breeding grounds for the pickerel which came in the autumn, like the anadromous fish to the ocean. They entered water that increased gradually in salinity. Having learned that this was the history of the former occupants of the lake the experiments of the North Dakota Biological Station were directed toward repeating artificially what had occurred in nature. Results have finally been obtained which are wholly successful. Evidences for this conclusion will be submitted in the complete discussion referred to in this abstract.

Sergius Morgulis (Carnegie Nutrition Laboratory): (1) *The Influence of Protracted and Intermittent Fasting upon Growth.* (2) *The Nervous System and Regeneration.*

C. C. Nutting (University of Iowa): *Can We get Together on the Nomenclature Question?*

The present situation is unsatisfactory, and a solution is greatly to be desired.

Points on which both parties are agreed: (1) That there should be definite laws of nomenclature, including priority. (2) That there should be a commission to interpret and administer these laws.

Position held by the International Commission on Zoological Nomenclature: (1) That no exception be allowed to the priority rule. (2) That no rule shall be modified except by unanimous vote of the commission. (3) That the commission be treated with the deference due an international court.

Position held by a large number of those who voted against the priority rule: (1) That there should be a reasonable "statute of limitation" by which names long in undisputed and general use should be excepted from priority rule. (2) That there should be an application of the principles of equity in special cases. (3) That a majority of the commission should have the power to propose changes in the rules of nomenclature, and to bring such changes to a vote by the International Commission. (4) That we retain the right of free criticism of the commission without being required to observe the etiquette supposed to govern international courts. The commission is the servant of its constituents the "common people" among the zoologists.

The present situation regarding the priority rule: (1) The commission "stands pat" in adhering to the position outlined above. (2) A majority of zoologists are opposed to the priority rule as administered. The commission has not secured the support of its constituency, and has no means of enforcing its decrees. There is a distinct tendency among working systematists to ignore the findings of the commission.

A tentative solution: (1) Adoption of a rule by which a two thirds majority of the commission can change any rule. (2) Recognition of the legal principles of (*a*) the statute of limitation and (*b*) the law of equity as applied to individual cases.

W. C. Curtis,
Secretary

SOCIETIES AND ACADEMIES

THE SOCIETY OF RESEARCH WORKERS IN EXPERIMENTAL BIOLOGY

At the meeting of this society held on December 18, 1912, at the University Club, Washington, D. C., Dr. William Salant, chief of the section of pharmacology, Bureau of Chemistry, U. S. Department of Agriculture, gave an exhaustive review of the literature on creatin and creatinine metabolism.

Especial stress was laid upon the elimination of creatin in various diseases affecting the muscles, the central nervous system and the liver.

The recent work of Mendel and his collaborators on the relation of carbohydrate metabolism to creatin, in which it was shown that a distinct relation probably exists between the formation of creatine and the amount of carbohydrates ingested, was discussed. In addition, the speaker gave a brief résumé of his own work on the influence of caffein on creatin and creatinine elimination, pointing out that under some conditions, such as starvation, caffein may cause a considerable increase in the output of creatine.

Other conditions affecting the elimination of creatine and creatinine such as temperature, the amount of age, the fate of ingested creatin and creatinine, and the metabolism of these substances in different animals, were dealt upon with some length.

Lewis W. Fetzer